www.mtg.in | June 2022 | Pages 80 | ₹ 40

Get Set Go for

NEET Class XI JEE Class XII

SOLVED PAPERS 2022

TERM-II CLASS XII

WB JEE • CBSE

CHEMISTRY today

India's #1
CHEMISTRY MONTHLY FOR
JEE (Main & Advanced) & NEET

CONCEPT MAP

MONTHLY TEST DRIVE

CLASS XI & XII

CELEBRATING 40 YEARS OF EXCELLENCE

mtG

Trust of more than
1 Crore Readers
Since 1982

CBSE warm up! Class XII

PRACTICE PAPERS

JEE MAIN ADVANCED | NEET | CUET (UG)

2022600013418

SCIENCE OLYMPIAD FOUNDATION

INSPIRING YOUNG MINDS THROUGH KNOWLEDGE OLYMPIADS

ANNOUNCES

Important: Applications must reach us by **August 31, 2022.**

AWARDS* & PRIZES

- Total awards / scholarships during 2019-20 approx. ₹ 18 Crores
- 30% increase in Zonal Awards
- Gold Medals of Excellence to top 10% in class
- Certificates & Performance Analysis Reports for all schools & students

THE WORLD'S BIGGEST OLYMPIADS

2022-23

Millions of students from 68,000+ schools in 1400+ cities and 48 countries competing in the 7 SOF Olympiads!

SCHOLARSHIPS

- Girl Child Scholarship Scheme - 300 Nos. ₹ 5,000 each
- Defence Services Academician Scholarship-260 Nos. ₹ 5,000 each +Trophy
- Academic Excellence Scholarship-260 Nos. ₹ 5,000 each +Trophy

FOR DETAILS

- Visit www.sofworld.org
- Visit www.facebook.com/sofworld
- Write to us at info@sofworld.org
- Call : 0124 - 4951200
- Check with your teacher

THE INSTITUTE OF Company Secretaries of India
भारतीय कम्पनी सचिव संस्थान
IN PURSUIT OF PROFESSIONAL EXCELLENCE
Statutory body under an Act of Parliament

PRESENTS

IGKO SOF INTERNATIONAL GENERAL KNOWLEDGE OLYMPIAD — 15 SEPT. | 11 OCT.

IEO SOF INTERNATIONAL ENGLISH OLYMPIAD — 22 SEPT. | 14 OCT. | 1 NOV.

NSO SOF NATIONAL SCIENCE OLYMPIAD — 18 OCT. | 3 NOV. | 1 DEC.

IMO SOF INTERNATIONAL MATHEMATICS OLYMPIAD — 10 NOV. | 22 NOV. | 13 DEC.

NCO SOF NATIONAL CYBER OLYMPIAD — 24 NOV. | 20 DEC.

ISSO SOF INTERNATIONAL SOCIAL STUDIES OLYMPIAD — 22 DEC. | 24 JAN.

ICO SOF INTERNATIONAL COMMERCE OLYMPIAD — 22 DEC. | 24 JAN.

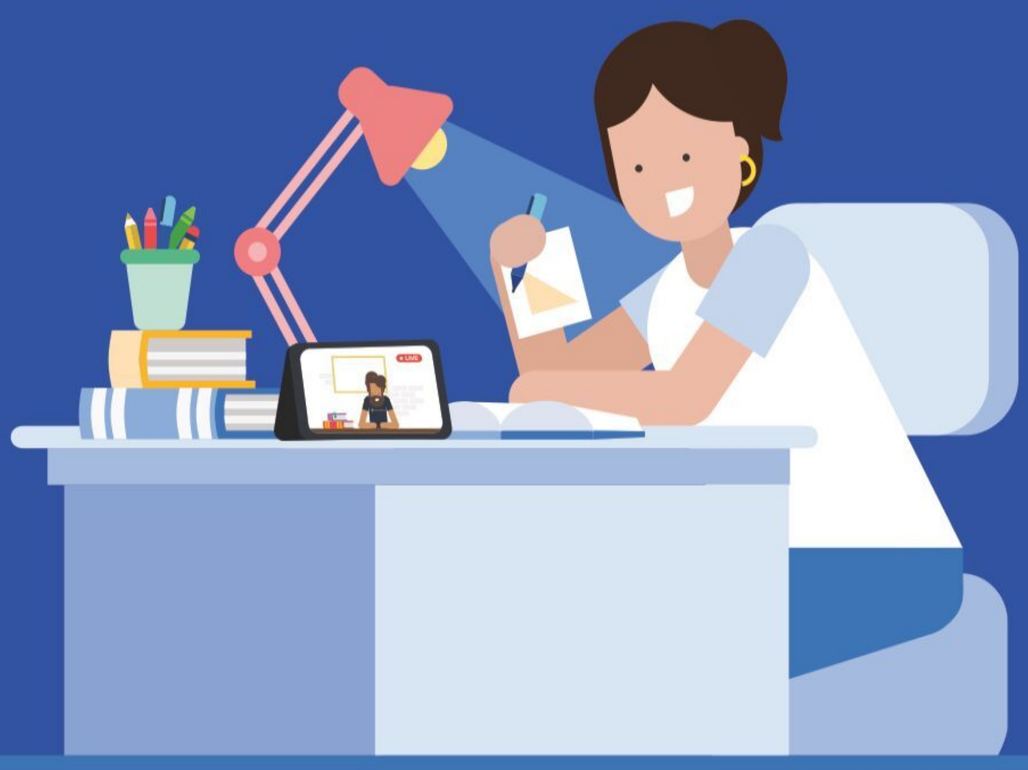
✓Plot No. 99, First Floor, Sector 44, Gurugram -122 003 (HR) Telefax: (0124)4951200, 09312680857/55

Regd. Office: 406, Taj Apt., Ring Road, New Delhi-110 029 | e-mail: info@sofworld.org

*T&C apply, please refer to prospectus & our site for details.

unacademy

India's Largest Learning Platform*



Get started with your learning journey with India's Top Educators

Follow 3 simple steps to get a 7-day free trial:

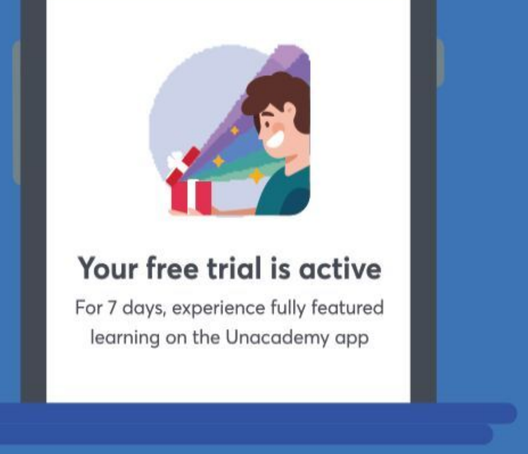
Step 1

Scan the QR code

Step 2

Register and choose your goal

Step 3



Start learning with a 7-day free trial

Use code **MTG10** to get 10%** off on your subscription

Learn on Unacademy

*Source: The Indian Edtech Story, Q1 2022 Round-Up by Markelytics. **T&C Apply.

unacademy

India's Largest Learning Platform*

Enhance your Chemistry preparation

Dr. Amit Bajpai

18+ Years of Teaching Experience
Author of 'Selected Problems of Organic Chemistry'

You have the power to accomplish your dreams. All you have to do is, take small and realistic steps towards achieving them. The first and most important thing is to believe in yourself. The next step is to choose a team of great mentors and a support system. This will help you achieve your dreams and begin your preparation with complete dedication and honesty.

This is where Unacademy can help you, with Top Educators and mentors by your side, you can strengthen your preparation.

Here are a few tips for your revision:

Strengthen your basics

Clear your fundamentals from your Class 11 and Class 12 NCERT textbooks before consulting any other reference material.

Practice

The best way to understand concepts is to practice. Clear all your doubts through detailed solutions. The 'Ask a Doubt' feature on the Unacademy App is super helpful in helping you solve all your doubts, for every topic.

Get the right study material

Choosing the right study material with NEET UG level practice questions is crucial for your preparation. Do not refer to a lot of different books. Study material designed by Top Educators is also available on the Unacademy App.

Be consistent

Maintain a study schedule and follow it. Consistent preparation with regular practice will help you achieve your goals.

Evaluate your preparation

Don't jump to taking Mock Tests directly. First clear your fundamentals then move on to chapter-wise practice. Take unit tests and full-length Mock Tests at the end. You can take these tests on Unacademy.

Chemistry is one of the most important and scoring subjects after Biology. As you know, there are three major parts of Chemistry - Physical, Inorganic and Organic. All three have equal weightage in the NEET UG examination. For Physical Chemistry, you have to mostly focus on formulas in every chapter as well was work on the calculations. In Organic, you have to strongly revise reaction mechanisms and named reactions. In Inorganic, you have to mostly revise NCERT concepts. Few topics such as polymers, biomolecules and Chemistry in everyday life are important as well.

Scan the QR Code to watch Free Classes

Sign up for the Batch Course using code MTG10 to get 10% off on the Unacademy Subscription**

*Source: The Indian Edtech Story: Q1 2022 Round-Up by Markelytics. **T&C Apply.

CHEMISTRY today

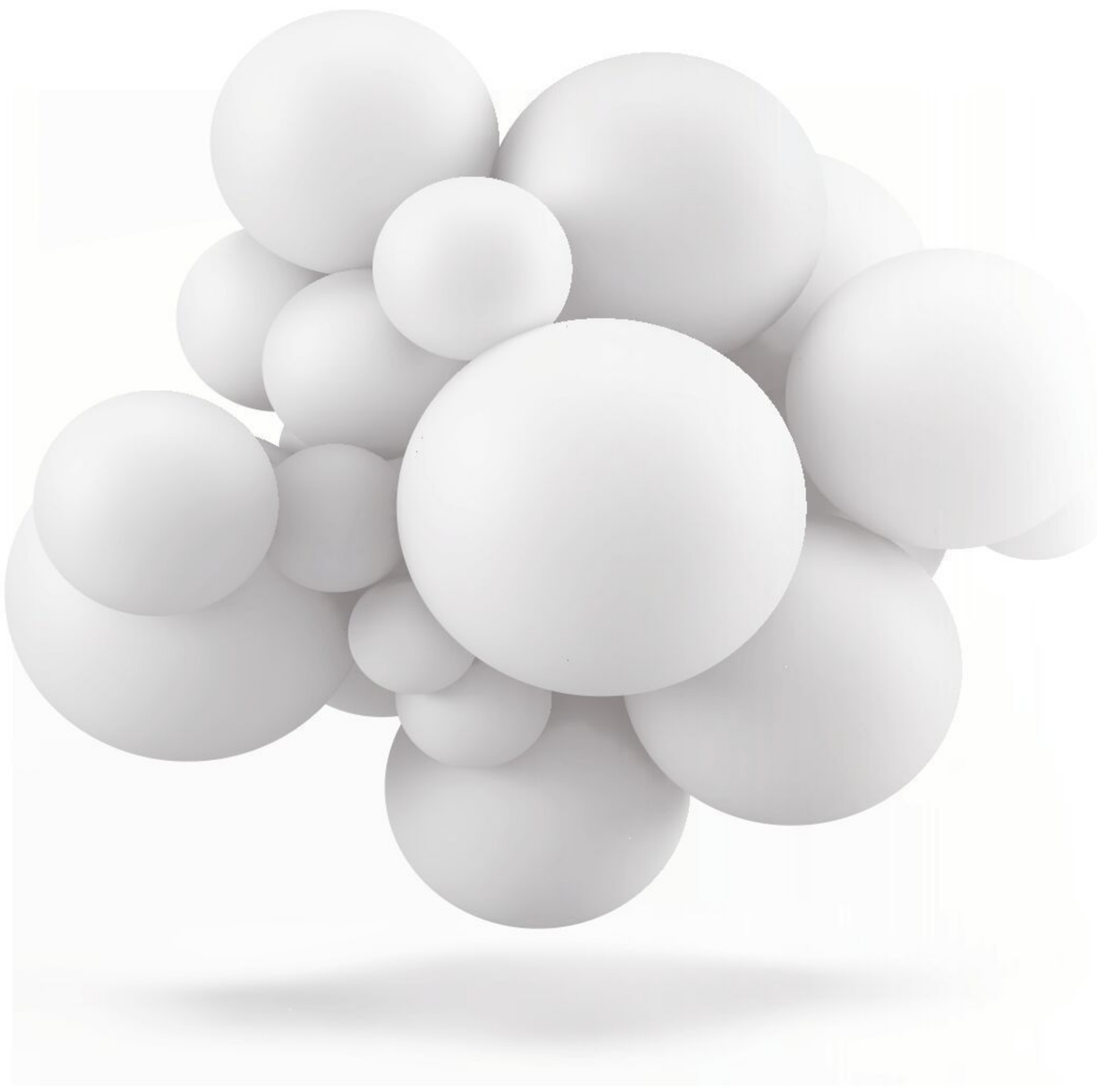
Volume 31 No. 6 June 2022

Managing Editor
Mahabir Singh

Editor
Anil Ahlawat

Corporate Office:
Plot 99, Sector 44 Institutional area, Gurugram -122 003 (HR).
Tel : 0124-6601200 e-mail : info@mtg.in website : www.mtg.in

Regd. Office:
406, Taj Apartment, Near Safdarjung Hospital, New Delhi - 110029.



CONTENTS

Subscribe online at www.mtg.in

Individual Subscription Rates				Combined Subscription Rates			
	9 months	15 months	27 months		9 months	15 months	27 months
Mathematics Today	300	500	850	PCM	900	1400	2500
Chemistry Today	300	500	850	PCB	900	1400	2500
Physics For You	300	500	850	PCMB	1200	1900	3400
Biology Today	300	500	850				

Send D.D/M.O in favour of MTG Learning Media (P) Ltd.
Payments should be made directly to : MTG Learning Media (P) Ltd,
Plot No. 99, Sector 44, Gurugram - 122003 (Haryana)
We have not appointed any subscription agent.

Printed and Published by Mahabir Singh on behalf of MTG Learning Media Pvt. Ltd. Printed at HT Media Ltd., B-2, Sector-63, Noida, UP-201307 and published at 406, Taj Apartment, Ring Road, Near Safdarjung Hospital, New Delhi - 110029.
Editor : Anil Ahlawat

PRACTICE PAPER 2022

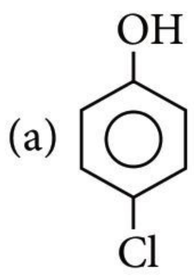
JEE MAIN

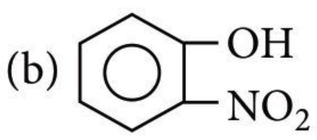
Exam Dates
Session-1
20th to 29th June
Session-2
21st to 30th July

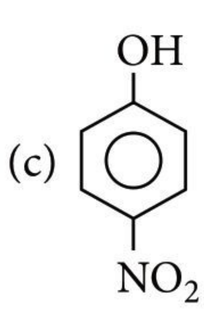
SECTION - A (MULTIPLE CHOICE QUESTIONS)

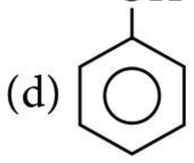
1. The monosaccharide constituents of lactose are
(a) α-*D*-Glucose and β-*D*-fructose
(b) α-*D*-Glucose and α-*D*-glucose
(c) β-*D*-Glucose and β-*D*-glucose
(d) β-*D*-Glucose and β-*D*-galactose.

2. Which of the following is strongest acid?

(a) 

(b) 

(c) 

(d) 

3. From the following list of atoms, choose the no. of pairs of isotopes, isobars and isotones respectively.

$^{16}_{8}O$, $^{39}_{19}K$, $^{235}_{92}U$, $^{40}_{19}K$, $^{14}_{7}N$, $^{18}_{8}O$, $^{14}_{6}C$, $^{40}_{20}Ca$, $^{238}_{92}U$

(a) 3, 2, 2 (b) 2, 3, 2
(c) 2, 2, 3 (d) 2, 2, 2

4. Which of the following oxides is formed when potassium metal is burnt in excess air?
(a) KO_3 (b) K_2O (c) K_2O_2 (d) KO_2

5. Match List-I with List-II and select the correct option.

List-I (Parameter)	**List-II (Unit)**
(A) Cell constant	(i) S cm^2 mol^{-1}
(B) Molar conductivity	(ii) Dimensionless
(C) Conductivity	(iii) m^{-1}
(D) Degree of dissociation	(iv) Ω^{-1} m^{-1} of electrolyte

(a) (A)-(i), (B)-(iv), (C)-(iii), (D)-(ii)
(b) (A)-(iii), (B)-(i), (C)-(ii), (D)-(iv)
(c) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)
(d) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

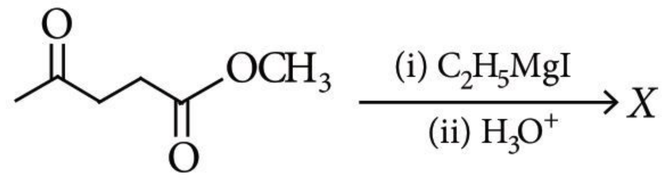
6. A binary solid has a primitive cubical structure with B^- ions constituting the lattice points and A^+ ions occupying 25% of its tetrahedral holes. The molecular formula of the crystal is
(a) A_2B (b) AB_3 (c) AB_2 (d) A_2B_3

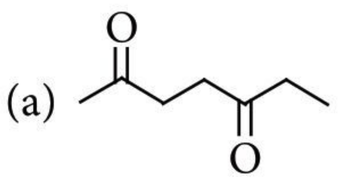
7. Which of the following order is correct for acidic property?
(a) $SiH_4 > PH_3 > H_2S$ (b) $SiH_4 = PH_3 = H_2S$
(c) $SiH_4 < PH_3 > H_2S$ (d) $SiH_4 < PH_3 < H_2S$

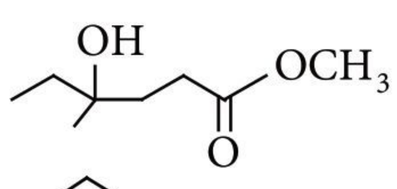
8. Which of the following has highest degree of hardness?
(a) Water with 1 mg $CaCl_2$ per litre
(b) Water with 1 mg $MgCl_2$ per litre
(c) Water with 1 mg $MgSO_4$ per litre
(d) All have equal values.

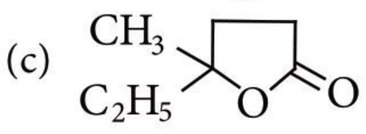
9. An electric current is passed through silver nitrate solution using silver electrodes. 10.79 g of silver was found to be deposited on the cathode. If the same amount of electricity is passed through copper sulphate solution using copper electrodes, the weight of copper deposited on the cathode is
(a) 6.4 g (b) 2.3 g (c) 3.2 g (d) 1.6 g

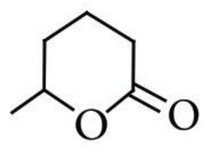
10. Give the structure of the compound *X* formed in the following reaction.



(a) 

(b) 

(c) 

(d) 

11. Mifepristone is used as
(a) antimicrobial (b) antimalarial
(c) antifertility drug (d) tranquillizer.

12. H_3PO_2 is the molecular formula of an acid of phosphorus. Its name and basicity respectively are
(a) phosphorous acid and two
(b) hypophosphorous acid and two
(c) hypophosphorous acid and one
(d) hypophosphoric acid and two.

13. Which gas would get absorbed when passed into a solution of $Al^{3+}_{(aq)}$?
(a) NH_3 (b) NO (c) CO (d) O_2

14. The direct conversion of *A* to *B* is difficult, hence it is carried out by the following shown path:

Given
$\Delta S_{(A \to C)} = 50$ e.u.; $\Delta S_{(C \to D)} = 30$ e.u.; $\Delta S_{(B \to D)} = 20$ e.u., where e.u. is the entropy unit, then $\Delta S_{(A \to B)}$ is
(a) +60 e.u. (b) +100 e.u.
(c) −60 e.u. (d) −100 e.u.

15. Equivalent mass of FeC_2O_4 in the reaction $FeC_2O_4 \longrightarrow Fe^{3+} + CO_2$ is
(a) M (b) $\frac{M}{2}$ (c) $\frac{M}{3}$ (d) $\frac{2M}{3}$

16. Which of the following is Hoffmann mustard oil reaction?
(a) Reaction of aromatic amine with iodoform
(b) Reaction of primary amine with $CHCl_3$
(c) Reaction of primary amine with CS_2 and $HgCl_2$
(d) Reaction of secondary amine with nitrous acid

17. Weight of 112 mL of oxygen at NTP on liquefaction would be
(a) 0.32 g (b) 0.64 g (c) 0.16 g (d) 0.96 g.

18. *neo*-Hexane can be best prepared by using the reaction sequence
(a) $(CH_3)_2CHCuLi + (CH_3)_3CCH_2Cl \rightarrow$
(b) $[(CH_3)_3C]_2CuLi + (CH_3)_2CHBr \rightarrow$
(c) $[(CH_3)_3C]_2CuLi + CH_3CH_2I \rightarrow$
(d) $(CH_3CH_2CH_2)_2CuLi + (CH_3)_3CBr \rightarrow$

19. Which of the following statements is incorrect?
(a) $B(OH)_3$ partially reacts with water to form H_3O^+ and $[B(OH)_4]^-$, and behaves like a weak acid.
(b) $B(OH)_3$ behaves like a strong monobasic acid in the presence of sugars, and this acid can be titrated against an NaOH solution using phenolphthalein as an indicator.
(c) $B(OH)_3$ does not donate a proton and hence does not form any salt with NaOH.
(d) On strong heating, $B(OH)_3$ gives B_2O_3.

20. Which of the following statement is false?
(a) Photochemical smog causes irritation in eyes.
(b) London smog is oxidizing in nature.
(c) London smog is a mixture of smoke and fog.
(d) Phtochemical smog results in the formation of PAN.

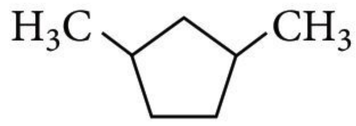
SECTION - B (NUMERICAL TYPE QUESTIONS)

Attempt any 5 questions out of 10.

21. The total no. of stereoisomers shown by $[Cr(NH_3)_4Cl_2]Br$ are _____.

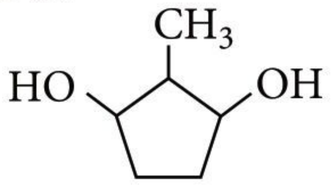
22. The van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The percentage degree of dissociation is _____.

23. How many monochlorinated products are possible in case of the following compound?



24. Nitrogen gas is present in 1 litre flask at a pressure of 7.6×10^{-8} mm of Hg at 0°C. If the number of nitrogen molecules in flask is $x \times 10^{12}$, then the value of x is _____.

25. How many different stereoisomers exist for the compound below?



26. A certain reaction, $A + B \rightarrow C$, is first order with respect to each reactant, with $k = 1.0 \times 10^{-2}$ L mol^{-1} s^{-1}. Calculate the concentration of *A* (in mol/L) remaining after 100 s if the initial concentration of each reactant was 0.100 M.

27. *X* is a polymer of *Y*. *Y* is formed from the Beckmann rearrangement of cyclohexanone oxime. The no. of atoms present in a ring in *Y* is _____.

28. Percentage of ionic character in HI bond if $\chi_H = 2.1$, $\chi_I = 2.5$ is _____.

29. Pyrolusite on heating with KOH in presence of air gives a dark green compound (*A*). The solution of (*A*) on treatment with H_2SO_4 gives a purple coloured compound (*B*). KI on reaction with

alkaline solution of (*B*) changes to a brown-black compound (*C*). The number of unpaired electrons in the cation of (*C*) is _____.

30. To 8.4 mL H_2O_2, excess of acidified solution of KI was added. The iodine liberated required 20 mL of 0.3N $Na_2S_2O_3$ solution. Volume strength of H_2O_2 solution is _____.

SOLUTIONS

1. (d)

2. (c) : *p*-Nitrophenol > *o*-Nitrophenol > *p*-Chlorophenol > Phenol

3. (a) : Isotopes (same atomic no. but different mass no.) : $(^{16}_{8}O, ^{18}_{8}O), (^{39}_{19}K, ^{40}_{19}K), (^{235}_{92}U, ^{238}_{92}U)$

Isobars (same mass no.) : $(^{40}_{19}K, ^{40}_{20}Ca), (^{14}_{7}N, ^{14}_{6}C)$

Isotones (same no. of neutrons): $(^{39}_{19}K, ^{40}_{20}Ca), (^{14}_{6}C, ^{16}_{8}O)$

4. (d) : $K + O_2 \xrightarrow{\text{Burning}} KO_2$

5. (c)

6. (c) : No. of lattice particles (B^-) = 1

No. of tetrahedral voids = 2

No. of tetrahedral voids occupied by (A^+) = $2 \times \frac{1}{4} = 1/2$

$\therefore$ Molecular formula = $A_{1/2}B_1 = AB_2$

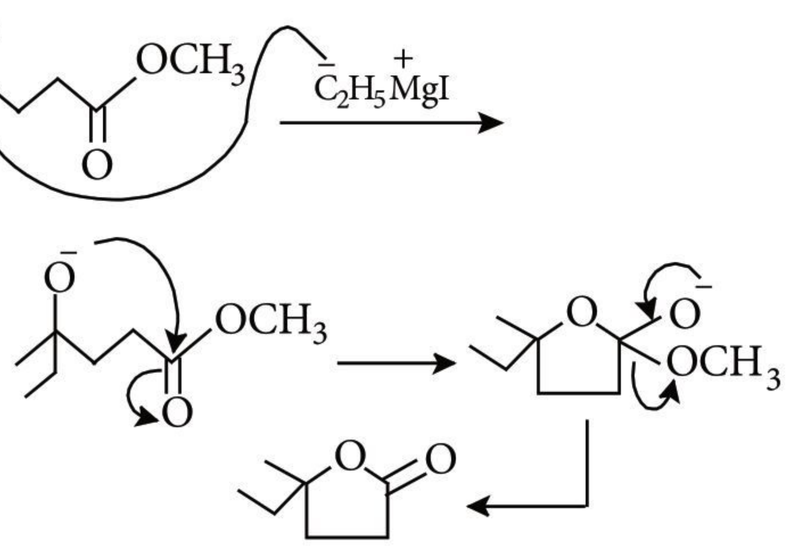
7. (d) : The acidic character of hydrides increases in a period for non-metals.

8. (b)

9. (c) : Applying $\frac{W_{Cu}}{W_{Ag}} = \frac{E_{Cu}}{E_{Ag}}$

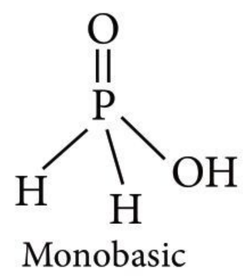
$$W_{Cu} = \frac{31.75}{108} \times 10.79 \approx 3.2 \text{ g}$$

10. (c) :



11. (c)

12. (c) : H_3PO_2 : Hypophosphorous acid



Monobasic

13. (a) : NH_3 is a basic compound while others are neutral, so it reacts readily with $Al^{3+}_{(aq)}$.

14. (a) : $\Delta S_{(A \to B)} = \Delta S_{(A \to C)} + \Delta S_{(C \to D)} - \Delta S_{(B \to D)}$

$= 50 + 30 - 20 = 60$ e.u.

15. (c) : $\overset{+2\ +3}{FeC_2O_4} \longrightarrow Fe^{3+} + \overset{+4}{CO_2}$

n-factor = 3

$$\text{Eq. wt.} = \frac{\text{Molar wt.}}{n\text{-factor}} = \frac{M}{3}$$

16. (c) : $RNH_2 + S{=}C{=}S \longrightarrow RNH{-}\overset{\overset{S}{\|}}{C}{-}SH$

$R{-}N{=}C{=}S + HgS + 2HCl \xleftarrow[\text{Heat}]{HgCl_2}$

Alkyl isothiocyanate

This reaction is called Hoffmann mustard oil reaction.

17. (c) : 22400 mL is the volume of O_2 at NTP.

$\therefore$ At NTP, 22400 mL of O_2 weigh = 32 g

$\therefore$ 112 ml of O_2 at NTP will weigh = $\frac{32}{22400} \times 112$

$= 0.16$ g of O_2

18. (c)

19. (c) : Boric acid being acidic in nature forms salt with NaOH known as metaborates.

$B(OH)_3 + NaOH \longrightarrow B(OH)_4^- + Na^+$

$Na^+BO_2^- + 2H_2O \longleftarrow$

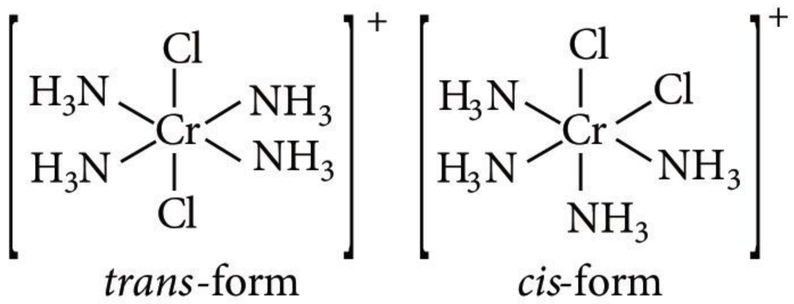
Sodium metaborate

EXAM ALERT 2022

Exam	Date
JEE Main	Session 1: 20th to 29th June Session 2: 21st to 30th July
COMEDK	19th June
SRMJEEE	Phase 3 : 25th and 26th June
BITSAT	Session-I: 2nd to 9th July Session-II: 3rd to 7th August
KEAM	4th July
VITEEE	30th June to 6th July
NEET	17th July
JEE Advanced	28th August

20.(b) : London smog is reducing in nature.

21.(2) : $[Cr(NH_3)_4Cl_2]Br$ is an octahedral compound and exists in two geometrical isomeric forms.



trans-form *cis*-form

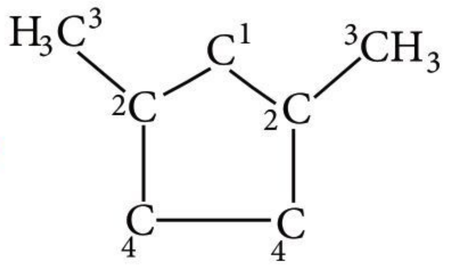
22.(87) : Degree of dissociation $(\alpha) = \frac{i-1}{n-1}$

n is number of ions produced from one molecule.

$$\alpha = \frac{2.74-1}{3-1} = \frac{1.74}{2} = 0.87$$

Degree of dissociation = 87%.

23.(4) :



It has four types of carbon, so total four types of monochlorinated products are possible.

24.(2.68) : As we know,

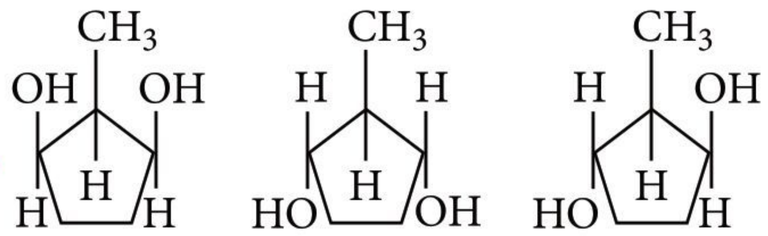
$$\text{Volume of } N_2 \text{ gas at STP } = \frac{1\times 7.6\times 10^{-8}}{760} = 10^{-10} \text{ L}$$

22.4 L of a gas at STP contains = 6.023×10^{23} molecules

$\therefore$ 10^{-10} L of a gas at STP contains

$$= \frac{6.023\times 10^{23}}{22.4}\times 10^{-10} = 2.68\times 10^{12}$$

25.(2) :



Achiral Achiral Chiral (d + l)

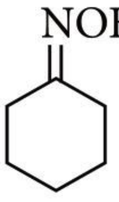
26.(0.091) : Since the concentrations of the reactants at the start are equal and remain equal throughout the reaction, the reaction can be treated as a simple second order reaction.

$$\frac{1}{[A]} = kt + \frac{1}{[A_0]} = 1.0\times 10^{-2}\,\text{L mol}^{-1}\,\text{s}^{-1} \times (100\text{ s}) + \frac{1\text{ L}}{0.100\text{ mol}}$$

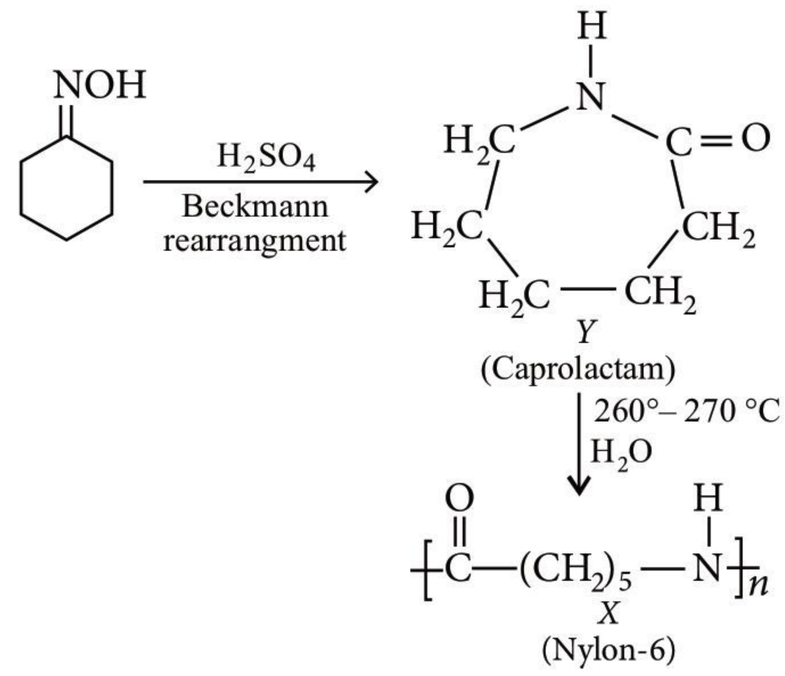
$$= 11 \text{ L/mol}$$

$[A] = 0.091$ M.

27.(7) : Y is formed by Beckmann rearrangement of



. So, Y is caprolactam.



28.(7) : $[16(\chi_I - \chi_H) + 3.5\,(\chi_I - \chi_H)^2]$

$$= [16(0.4) + 3.5(0.4)^2] = 6.96 \approx 7$$

29.(3) : Pyrolusite (MnO_2), on heating with KOH in presence of air gives potassium manganate which is a green coloured compound (A). The purple coloured compound (B) will be potassium permanganate. Potassium permanganate is a good oxidising reagent both in alkaline and acidic medium.

Reaction of MnO_2 with KOH

$$\underset{\text{(Pyrolusite)}}{MnO_2} + 4KOH + [O_2] \xrightarrow{\Delta} \underset{(A)\text{ (dark green)}}{K_2MnO_4} + 2H_2O$$

$$3K_2MnO_4 + 2H_2O \xrightarrow{\text{Dil. } H_2SO_4} \underset{(B)\text{(purple)}}{2KMnO_4} + MnO_2 + 4KOH$$

$$2KMnO_4 + KI + H_2O \longrightarrow KIO_3 + 2MnO_2 + 2KOH$$

(C)

Oxidation state of Mn in compound (C) is +4.

So, electronic configuration of Mn^{4+} is

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

No. of unpaired electrons = 3.

30.(4) : $H_2O_2 + 2I^- + 2H^+ \longrightarrow 2H_2O + I_2$

$I_2 + 2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2I^-$

$\underset{(H_2O_2)}{N_1V_1} = \underset{(Na_2S_2O_3)}{N_2V_2}$

$N_1 \times 8.4 = 0.3 \times 20 \implies N_1 = 0.7143$

Normality of H_2O_2 is related to x (volume strength) by relation, $N = \frac{x}{5.6} \implies x = N_1 \times 5.6 = 0.7143 \times 5.6 = 4$

◈◈

MONTHLY TEST DRIVE CLASS XI ANSWER KEY

1.	(b)	**2.**	(a)	**3.**	(b)	**4.**	(d)	**5.**	(c)
6.	(c)	**7.**	(b)	**8.**	(b)	**9.**	(c)	**10.**	(a)
11.	(d)	**12.**	(a)	**13.**	(b)	**14.**	(c)	**15.**	(b)
16.	(d)	**17.**	(c)	**18.**	(d)	**19.**	(d)	**20.**	(a,d)
21.	(a,b)	**22.**	(a,b,c)	**23.**	(a,b,c)	**24.**	(8.4)	**25.**	(15)
26.	(3)	**27.**	(c)	**28.**	(b)	**29.**	(b)	**30.**	(d)

JEE 2022 PRACTICE PAPER ADVANCED

Exam on 28th August

PAPER - I

SECTION 1

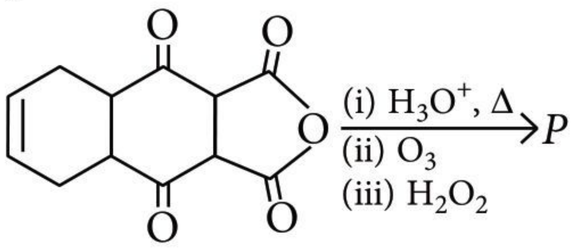
- *This section contains FOUR (04) questions.*
- *Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is the correct answer.*
- *For each question, choose the correct option corresponding to the correct answer.*
- *Answer to each question will be evaluated according to the following marking scheme:*

Full Marks : +3 *If ONLY the correct option is chosen.*

Zero Marks : 0 *If none of the options is chosen (i.e., the question is unanswered).*

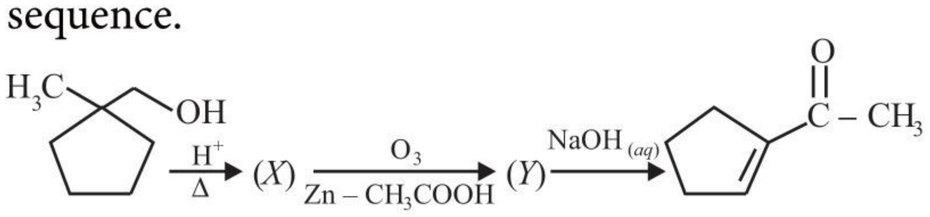
Negative Marks : −1 *In all other cases.*

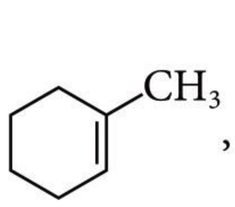
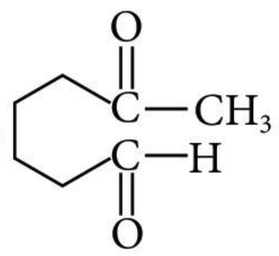
1. The total number of carboxylic acid groups in the product *P* is/are :

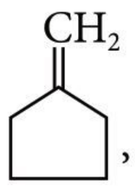
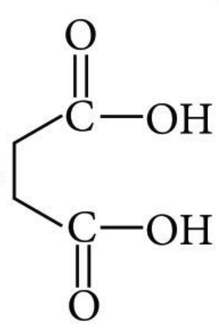


(a) 4 (b) 2 (c) 1 (d) 3

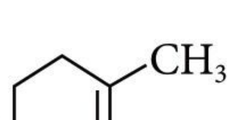
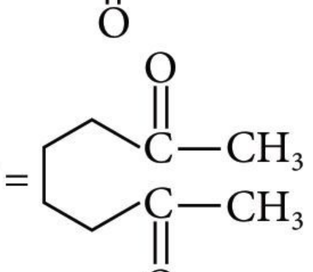
2. Identify (*X*) and (*Y*) in the following reaction sequence.



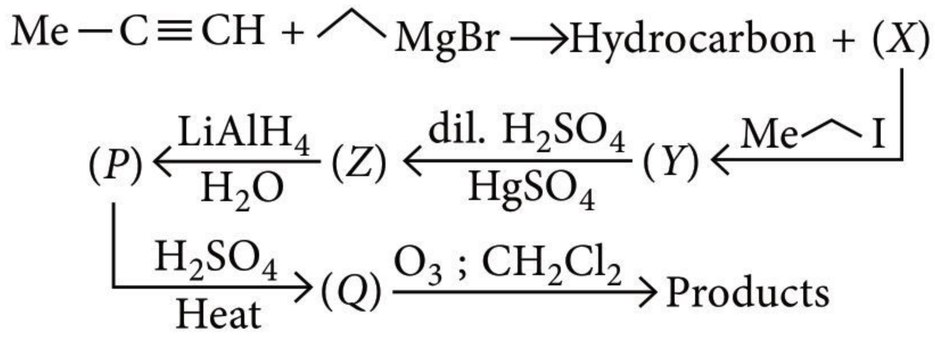
(a) $X =$  , $Y =$ 

(b) $X =$  , $Y =$ 

(c) $X =$, $Y =$

(d) $X =$  , $Y =$ 

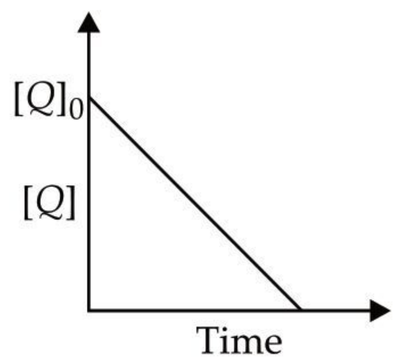
3. For the given sequence of reactions



Number of products obtained finally is

(a) 3 (b) 4 (c) 2 (d) 6

4. In the reaction, $P + Q \rightarrow R + S$, the time taken for 75% reaction of *P* is twice the time taken for 50% reaction of *P*. The concentration of *Q* varies with reaction time as shown in the figure. The overall order of the reaction is



(a) 2 (b) 3 (c) 0 (d) 1

SECTION 2

- *This section contains THREE (03) question stems.*
- *There are TWO (02) questions corresponding to each question stem.*
- *The answer to each question is a NUMERICAL VALUE.*
- *For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.*

- *If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.*
- *Answer to each question will be evaluated according to the following marking scheme:*

Full Marks :	*+2*	*If ONLY the correct numerical value is entered at the designated place*
Zero Marks :	*0*	*In all other cases.*

Question Stem for Question Nos. 5 and 6

Question Stem

The hydrogen-like species Li^{2+} is in a spherically symmetric state S_1 with one radial node. Upon absorbing light the ion undergoes transition to a state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

5. Energy of the state S_1 in units of the hydrogen atom ground state energy is _____.

6. The orbital angular momentum quantum number of the state S_2 is _____.

Question Stem for Question Nos. 7 and 8

Question Stem

An aromatic hydrocarbon (*A*) $C_{16}H_{16}$ shows following reactions :

(i) It decolourizes both Br_2 in CCl_4 and cold aq. $KMnO_4$

(ii) It adds an equimolar amount of H_2

(iii) Oxidation with $KMnO_4$ gives a dicarboxylic acid (*B*) $C_6H_4(COOH)_2$ which gives only one monobromo substitution product.

7. Number of sp^3 carbon atoms in (*A*) is _____.

8. The number of stereoisomers of the compound (*A*) is _____.

Question Stem for Question Nos. 9 and 10

Question Stem

Tollens' reagent is used for the detection of aldehyde when a solution of $AgNO_3$ is added to glucose with NH_4OH then gluconic acid is formed.

$Ag^+ + e^- \longrightarrow Ag$; $E^\circ_{red} = 0.8$ V

$C_6H_{12}O_6 + H_2O \longrightarrow$ Gluconic acid $(C_6H_{12}O_7) + 2H^+ + 2e^-$; $E^\circ_{oxd} = -0.05$ V

9. $2Ag^+ + C_6H_{12}O_6 + H_2O \longrightarrow 2Ag_{(s)} + C_6H_{12}O_7 + 2H^+$

Find $\ln K$ of this reaction.

10. When ammonia is added to the solution, pH is raised to 11. The E_{red} increases by a factor x from E°_{red}. Determine the value of x.

[Use $2.303 \times \frac{RT}{F} = 0.0591$ and $\frac{F}{RT} = 38.92$ at 298 K]

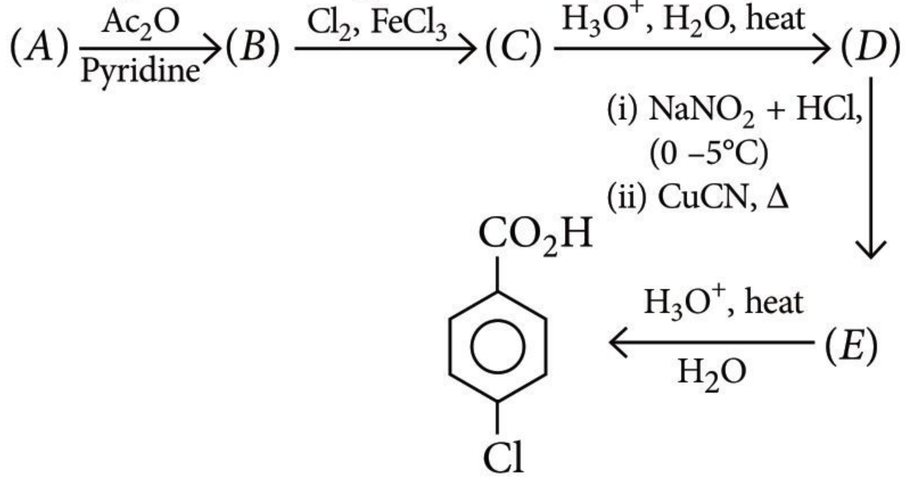
SECTION 3

- *This section contains SIX (06) questions.*
- *Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).*
- *For each question, choose the option(s) corresponding to (all) the correct answer(s).*
- *Answer to each question will be evaluated according to the following marking scheme:*

Full Marks :	*+4*	*If only (all) the correct option(s) is(are) chosen;*
Partial Marks :	*+3*	*If all the four options are correct but ONLY three options are chosen;*
Partial Marks :	*+2*	*If three or more options are correct but ONLY two options are chosen, both of which are correct;*
Partial Marks :	*+1*	*If two or more options are correct but ONLY one option is chosen and it is a correct option;*
Zero Marks :	*0*	*If unanswered;*
Negative Marks :	*–2*	*In all other cases.*

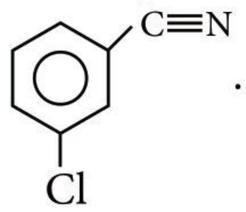
For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then
choosing ONLY (a), (b) and (d) will get +4 marks;
choosing ONLY (a) and (b) will get +2 marks;
choosing ONLY (a) and (d) will get +2 marks;
choosing ONLY (b) and (d) will get +2 marks;
choosing ONLY (a) will get +1 mark;
choosing ONLY (b) will get +1 mark;
choosing ONLY (d) will get +1 mark;
choosing no option(s) (i.e., the question is unanswered) will get 0 marks and
choosing any other option(s) will get –2 marks.

11. Compound (*A*) having molecular formula C_6H_7N, undergoes following reaction sequence :

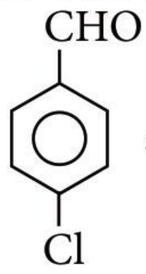


Select the correct statement(s) for the reaction sequence.

(a) D is less basic than A.

(b) Compound (A) on reaction with $CHCl_3$ and alc. KOH results in formation of  .

(c) Reactivity order towards aromatic electrophilic substitution is $A > B$.

(d) Compound (E) on reaction with $SnCl_2$, HCl followed by H_3O^+ gives  as a major product.

12. 1.2575 g sample of $[Cr(NH_3)_6]SO_4Cl$ (Mol. wt. = 251.5) is dissolved to prepare 250 mL solution showing an osmotic pressure of 1.478 atm at 27°C. Which of the following statements is/are correct about this solution?

(a) Given complex furnishes three ions in solution.

(b) The van't Hoff factor is 3.

(c) The equilibrium molarity of $[Cr(NH_3)_6]\ SO_4Cl = 0.01$ M.

(d) The molarity of $[Cr(NH_3)_6]^{3+} = 0.02$ M after dissociation.

13. Successive ionization energies (in kJ/mol) of element A are given below :

$I.E._1$	$I.E._2$	$I.E._3$
520	7300	12000

If A reacts with different elements, which compounds is/are possible ?

(a) AF (b) A_2O (c) A_3N (d) A_3N_2

14. Based on the compounds of group 15 elements, the correct statement(s) is (are)

(a) Bi_2O_5 is more basic than N_2O_5

(b) NF_3 is more covalent than BiF_3

(c) PH_3 boils at lower temperature than NH_3

(d) the N—N single bond is stronger than the P—P single bond.

15. The correct statement(s) about the following reaction sequence is(are)

$$\text{Cumene } (C_9H_{12}) \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) } O_2} P \xrightarrow[\text{NaOH}]{CHCl_3/} \underset{\text{(Major)}}{Q} + \underset{\text{(Minor)}}{R}$$

$$Q \xrightarrow[PhCH_2Br]{NaOH} S$$

(a) R is steam volatile.

(b) Q gives dark violet colouration with 1% aqueous $FeCl_3$ solution.

(c) S gives yellow precipitate with 2, 4-dinitrophenyl-hydrazine.

(d) S gives dark violet colouration with 1% aqueous $FeCl_3$ solution.

16. The values of two lattice energies are given below:

NaF – 915 kJ mol^{-1}; MgO – 3933 kJ mol^{-1}

Which of the following correct statements help to explain the difference between these two values?

(a) In each of these compounds, the ions are isoelectronic.

(b) The attraction between doubly charged ions is about four times than that between singly charged ions.

(c) The interionic distance in NaF is greater than that in MgO.

(d) The interionic distance in NaF is smaller than that in MgO.

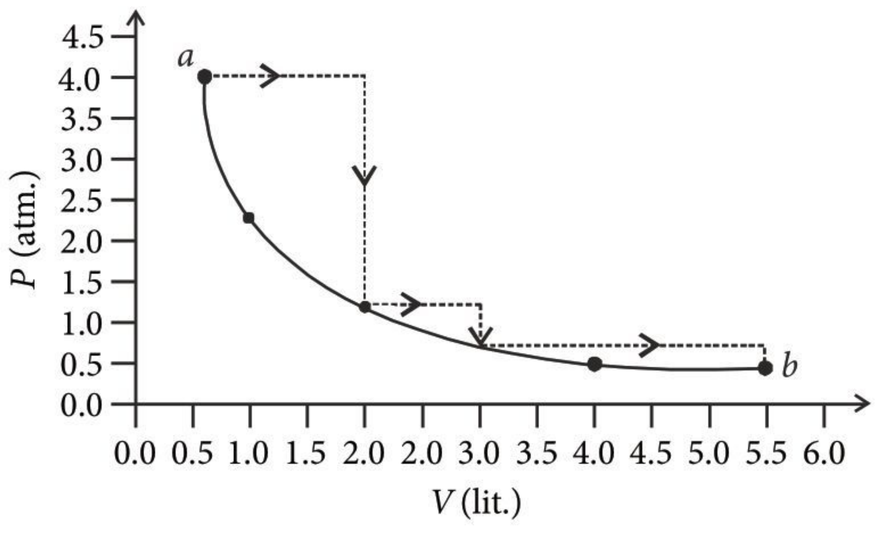
SECTION 4

- ***This section contains THREE (03) questions.***
- ***The answer to each question is a NON-NEGATIVE INTEGER.***
- ***For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks : ***+4*** ***If ONLY the correct integer is entered;***

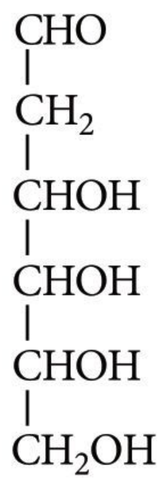
Zero Marks : ***0*** ***In all other cases.***

17. One mole of an ideal gas is taken from a to b along two paths denoted by the solid and the dashed lines as shown in the graph below. If the work done along the solid line path is w_s and that along the dotted line path is w_d, the integer closest to the ratio w_d/w_s is



18. Among H_2, He_2^+, Li_2, Be_2, B_2, C_2, N_2, O_2^- and F_2 the number of diamagnetic species is (Atomic numbers: H = 1, He = 2, Li = 3, Be = 4, B= 5, C = 6, N = 7, O = 8, F = 9)

19. When the following aldohexose exists in its *D*-configuration, the total number of stereoisomers in its pyranose form is _____.



PAPER - II

SECTION 1

- ***This section contains SIX (06) questions.***
- ***Each question has FOUR options (a), (b), (c) and (d). ONE OR MORE THAN ONE of these four option(s) is (are) correct answer(s).***
- ***For each question, choose the option(s) corresponding to (all) the correct answer(s).***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+4***	***If only (all) the correct option(s) is(are) chosen;***
Partial Marks :	***+3***	***If all the four options are correct but ONLY three options are chosen;***
Partial Marks :	***+2***	***If three or more options are correct but ONLY two options are chosen, both of which are correct;***
Partial Marks :	***+1***	***If two or more options are correct but ONLY one option is chosen and it is a correct option;***
Zero Marks :	***0***	***If unanswered;***
Negative Marks :	***–2***	***In all other cases.***

For example, in a question, if (a), (b) and (d) are the ONLY three options corresponding to correct answers, then
choosing ONLY (a), (b) and (d) will get +4 marks;
choosing ONLY (a) and (b) will get +2 marks;
choosing ONLY (a) and (d) will get +2 marks;
choosing ONLY (b) and (d) will get +2 marks;
choosing ONLY (a) will get +1 mark;
choosing ONLY (b) will get +1 mark;
choosing ONLY (d) will get +1 mark;
choosing no option(s) (i.e. the question is unanswered) will get 0 marks and
choosing any other option(s) will get –2 marks.

1. Which of the following statement(s) is(are) correct?
(a) The coordination number of each type of ion in CsCl crystal is 8.
(b) A metal that crystallizes in *bcc* structure has a coordination number of 12.
(c) A unit cell of an ionic crystal shares some of its ions with other unit cells.
(d) The length of the unit cell in NaCl is 552 pm. (r_{Na^+} = 95 pm; r_{Cl^-} = 181 pm).

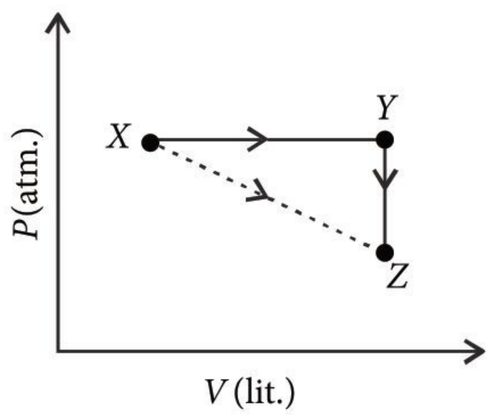
2. Which of the following statement(s) is(are) correct ?
(a) A plot of log K_p versus $1/T$ is linear.
(b) A plot of log [X] versus time is linear for a first order reaction, $X \rightarrow P$.
(c) A plot of p versus $1/T$ is linear at constant volume.
(d) A plot of p versus $1/V$ is linear at constant temperature.

3. The pair(s) of reagents that yield paramagnetic species is (are) _____.
(a) Na and excess of NH_3
(b) K and excess of O_2
(c) Cu and dilute HNO_3
(d) O_2 and 2-ethylanthraquinol.

4. For Mn^{3+} pairing energy is 28000 cm^{-1}, Δ_o for $[Mn(CN)_6]^{3-}$ is 38500 cm^{-1}, then which of the following is/are correct?
(a) Complex will be high spin complex.
(b) Complex will be low spin complex.
(c) Net CFSE = – 33600 cm^{-1}
(d) Magnetic moment of Mn^{3+} in the complex is 2.83 B.M.

5. Upon heating with Cu_2S, the reagent(s) that give copper metal (is) are
(a) $CuFeS_2$ (b) CuO
(c) Cu_2O (d) $CuSO_4$

6. For an ideal gas, consider only P-V work in going from an initial state X to the final state Z. The final state Z can be reached by either of the two paths shown in the figure.



Which of the following choice(s) is(are) correct?
[Take ΔS as change in entropy and w as work done]

(a) $\Delta S_{X \to Z} = \Delta S_{X \to Y} + \Delta S_{Y \to Z}$

(b) $w_{X \to Z} = w_{X \to Y} + w_{Y \to Z}$

(c) $w_{X \to Y \to Z} = w_{X \to Y}$

(d) $\Delta S_{X \to Y \to Z} = \Delta S_{X \to Y}$

SECTION 2

- ***This section contains THREE (03) question stems.***
- ***There are TWO (02) questions corresponding to each question stem.***
- ***The answer to each question is a NUMERICAL VALUE.***
- ***For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.***
- ***If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+2***	***If ONLY the correct numerical value is entered at the designated place;***
Zero Marks :	***0***	***In all other cases.***

Question Stem for Question Nos. 7 and 8

Question Stem

A compound *A* with molecular formula $C_{10}H_{13}Cl$ gives a white precipitate on adding silver nitrate solution. *A* on reacting with alcoholic KOH gives compound *B* as the main product. *B* on ozonolysis gives *C* and *D*. C gives Cannizzaro reaction but not aldol condensation. *D* gives aldol condensation but not Cannizzaro reaction.

7. Total number of C = C bonds in (*D*) is _____.

8. If the number of H-atoms in (*C*) is x and number of O atoms in (*D*) is y, then value of $(x + y)$ is _____.

Question Stem for Question Nos. 9 and 10

Question Stem

$A + 2B + 3C \rightleftharpoons AB_2C_3$

Reaction of 6.0 g of *A*, 6.0×10^{23} atoms of *B*, and 0.036 mol of *C* yields 4.8 g of compound AB_2C_3. If the atomic mass of *A* and *C* are 60 and 80 amu. (Given: Avogadro no. = 6×10^{23})

9. Calculate the number of moles of *B* participated in the reaction.

10. The atomic mass of *B* is _____ amu.

Question Stem for Question Nos. 11 and 12

Question Stem

When a metal rod *M* is dipped into an aqueous colourless concentrated solution of compound *N*, the solution turns light blue. Addition of aqueous NaCl to the blue solution gives a white precipitate *O*. Addition of aqueous NH_3 dissolves *O* and gives an intense blue solution.

11. Number of unpaired electron in *M* atom is:

12. The final solution contains two complex compounds (*A*) and (*B*). Total number of NH_3 ligands in (*A*) and (*B*) is _____.

SECTION 3

- ***This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) questions.***
- ***Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is the correct answer.***
- ***For each question, choose the option corresponding to the correct answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

Full Marks :	***+3***	***If ONLY the correct option is chosen;***
Zero Marks :	***0***	***If none of the options is chosen (i.e., the question is unanswered);***
Negative Marks :	***–1***	***In all other cases.***

Paragraph-1

The reactions of Cl_2 gas with cold-dilute and hot-concentrated NaOH in water give sodium salts of two (different) oxoacids of chlorine, *P* and *Q*, respectively. The Cl_2 gas reacts with SO_2 gas, in presence of charcoal, to give a product *R*. *R* reacts with white phosphorus to give a compound *S*. On hydrolysis, *S* gives an oxoacid of phosphorus, *T*.

13. *R*, *S* and *T*, respectively, are

(a) SO_2Cl_2, PCl_5 and H_3PO_4

(b) SO_2Cl_2, PCl_3 and H_3PO_3

(c) $SOCl_2$, PCl_3 and H_3PO_2

(d) $SOCl_2$, PCl_5 and H_3PO_4

14. *P* and *Q*, respectively, are the sodium salts of

(a) hypochlorus and chloric acids

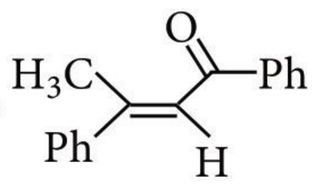
(b) hypochlorus and chlorus acids

(c) chloric and perchloric acids

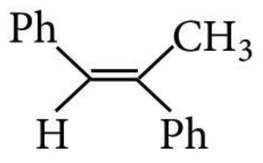
(d) chloric and hypochlorus acids.

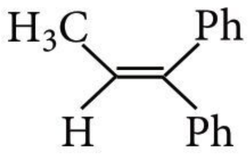
Paragraph-2

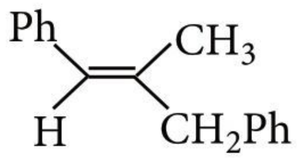
A tertiary alcohol *H* upon acid catalysed dehydration gives a product *I*. Ozonolysis of *I* leads to compounds *J* and *K*. Compound *J* upon reaction with KOH gives benzyl alcohol and a compound *L*, whereas *K* on reaction with KOH gives only *M*.

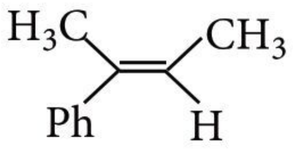
M = 

15. The structure of compound *I* is

(a) 

(b) 

(c) 

(d) 

16. The structures of compound *J*, *K* and *L*, respectively, are

(a) $PhCOCH_3$, $PhCH_2COCH_3$ and $PhCH_2COO^-K^+$

(b) PhCHO, $PhCH_2CHO$ and $PhCOO^-K^+$

(c) $PhCOCH_3$, $PhCH_2CHO$ and $CH_3COO^-K^+$

(d) PhCHO, $PhCOCH_3$ and $PhCOO^-K^+$

SECTION 4

- ***This section contains THREE (03) questions.***
- ***The answer to each question is a NON-NEGATIVE INTEGER.***
- ***For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.***
- ***Answer to each question will be evaluated according to the following marking scheme:***

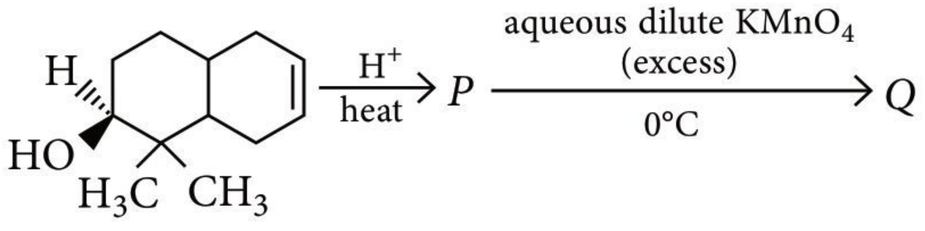
Full Marks : **+4** ***If ONLY the correct integer is entered;***

Zero Marks : **0** ***In all other cases.***

17. Among PbS, CuS, HgS, MnS, Ag_2S, NiS, CoS, Bi_2S_3 and SnS_2, the total number of black coloured sulphides is _____.

18. In 1 L saturated solution of AgCl [K_{sp}(AgCl) = 1.6×10^{-10}], 0.1 mol of CuCl [K_{sp}(CuCl) = 1.0×10^{-6}] is added. The resultant concentration of Ag^+ in the solution is 1.6×10^{-x}. The value of x is _____.

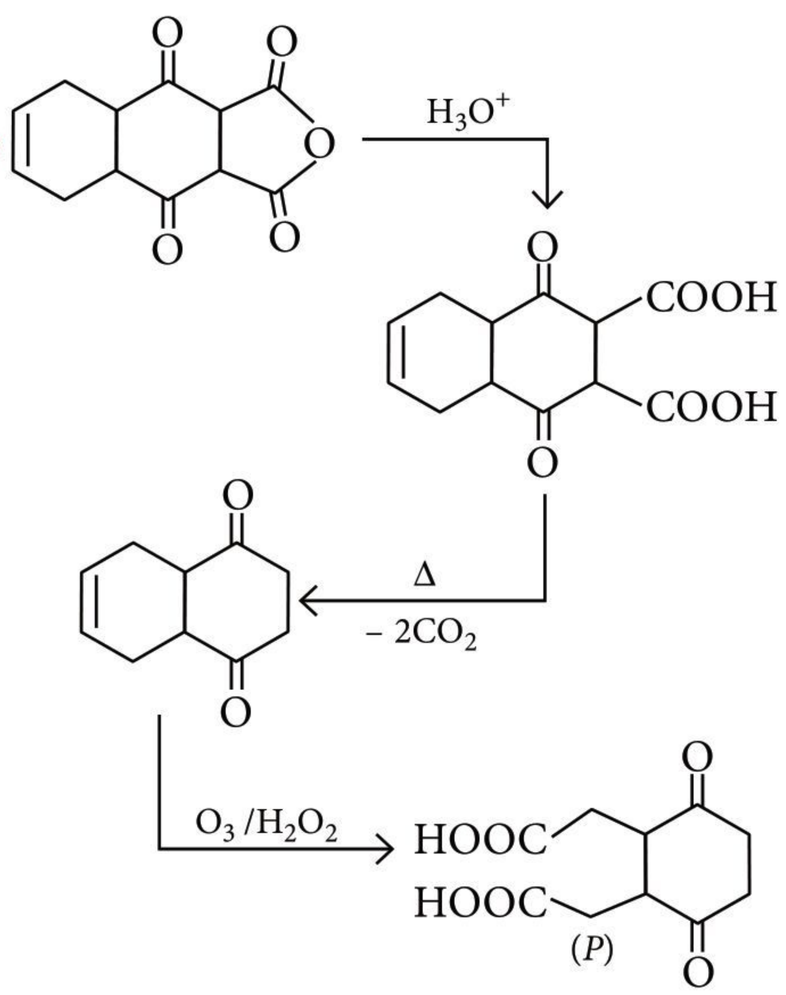
19. The number of hydroxyl group(s) in *Q* is _____.



SOLUTIONS

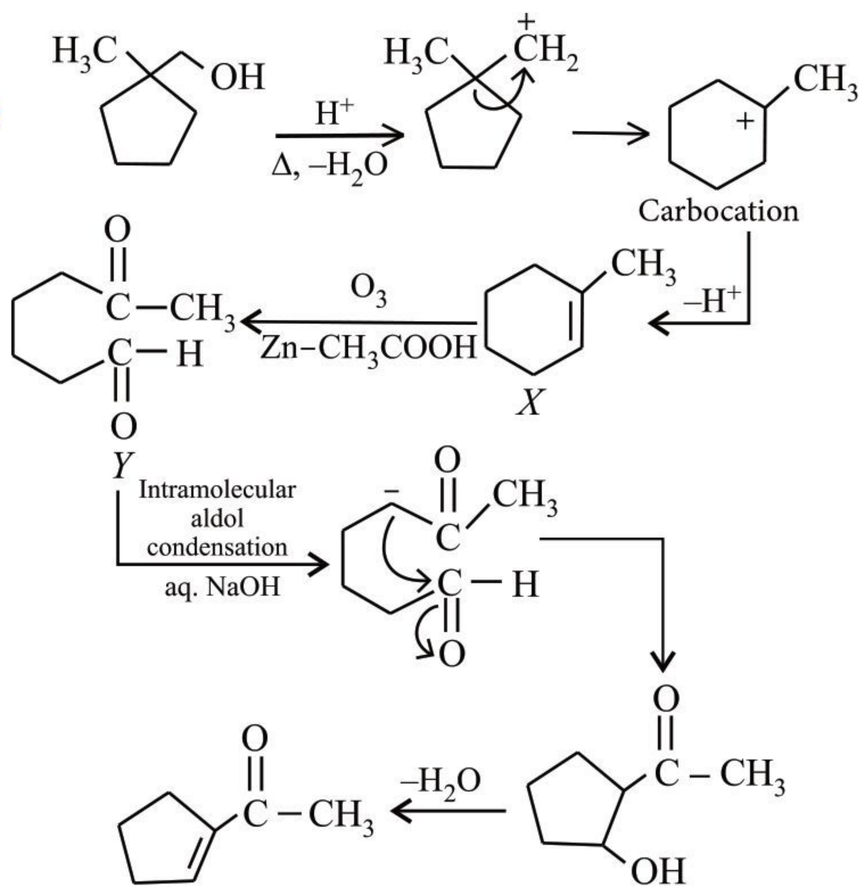
PAPER - I

1. (b) :



Number of —COOH groups in product (*P*) is 2.

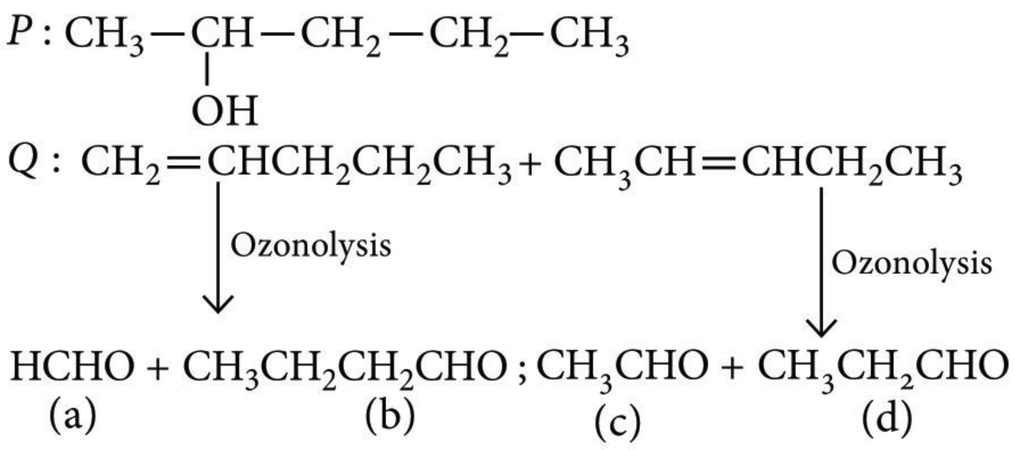
2. (a) :



3. (b) : $X : CH_3-C\equiv\overset{-}{C}\overset{+}{M}gBr$

$Y : CH_3-C\equiv C-CH_2-CH_3$

$Z : CH_3-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-CH_3$



4. (d)

5. (2.25) : It is given that the state S_1 has one radial node or $(n - l - 1) = 1$.

It is possible only when state S_1 is $2s$ with $n = 2$ and $l = 0$ (since S_1 is spherically symmetrical).

For S_1 state of Li^{2+}, $n = 2$ and $Z = 3$.

$\therefore$ Energy of state S_1 in the units of hydrogen atom ground state energy is :

$$E = E_H \times \frac{Z^2}{n^2} = E_H \times \frac{3^2}{2^2} = \frac{9}{4} E_H = 2.25 \times E_H$$

6. (1) : The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom. This is possible only for $3p$ orbital.

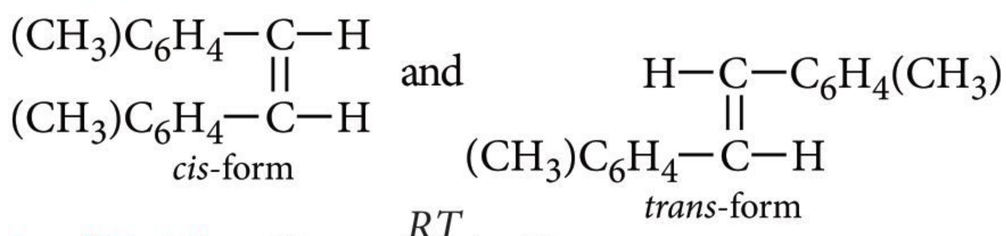
$3p$ orbital has one radial node, $n = 3$, $l = 1$

$$\Rightarrow \quad 3 - 1 - 1 = 1 \; ; \; E = E_H \times \frac{Z^2}{n^2} = E_H \times \frac{3^2}{3^2} = E_H$$

For $3p$ orbital, orbital angular momentum quantum no. (l) is 1.

7. (2)

8. (2) : (A) shows geometrical isomerism,



9. (58.45) : $E^\circ_{cell} = \frac{RT}{nF} \ln K$

$$0.8 - 0.05 = \frac{0.0591}{2 \times 2.303} \ln K$$

$$\therefore \quad \ln K = \frac{(0.8 - 0.05) \times 2 \times 2.303}{0.0591} = 58.45$$

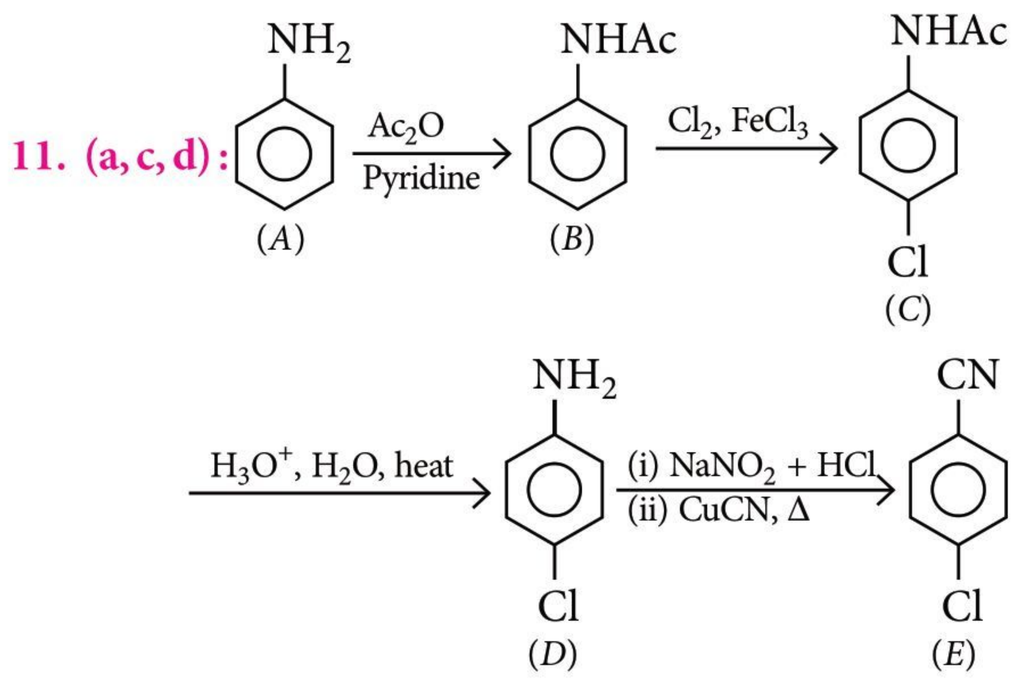
10. (0.65) : On increasing concentration of NH_3, the concentration of H^+ ion decreases.

$$E_{red} = E^\circ_{red} - \frac{0.0591}{n} \log[H^+]$$

$$E_{red} = E^\circ_{red} - \frac{0.0591}{1} \log 10^{-11}$$

$$= E^\circ_{red} - 0.0591 \times (-11) = E^\circ_{red} + 0.65$$

11. (a, c, d) :



Compound (A) on reaction with $CHCl_3$ and alc. KOH results in formation of C_6H_5NC.

12. (a,b,d) : Molarity $= \frac{w \times 1000}{M \times V_{(mL)}} = \frac{1.2575 \times 1000}{251.5 \times 250}$

$= 0.02$ M

$\pi = CRT$

$\therefore \quad \pi_{cal} = 0.02 \times 0.0821 \times 300 = 0.4926$ atm

$$\frac{\pi_{obs}}{\pi_{cal}} = i = \frac{1.478}{0.4926} = 3$$

As the given complex is dissociated as,

$$[Cr(NH_3)_6]SO_4Cl \rightarrow [Cr(NH_3)_6]^{3+} + SO_4^{2-} + Cl^-$$

	0.02	0	0	0
Conc. at time t	0	0.02	0.02	0.02

13. (a,b,c) **14. (a, b, c)** **15. (b, c)**

16. (b, c) : Higher magnitude of charge and smaller interionic radius of MgO are responsible for higher lattice energy.

17. (2) : Solid line path work done (w_s) is isothermal because PV is constant (Boyle's law) and dashed line (horizontal) path work done w_d is isobaric. Work done in vertical line is zero as $\Delta V = 0$.

Total work done on solid line path (w_s)

$$= 2.303\, nRT \log \frac{V_2}{V_1}$$

$$2.303\, PV \log \frac{V_2}{V_1} = 2.303 \times 4 \times 0.5 \log \frac{5.5}{0.5} = 4.8 \text{ L-atm.}$$

Total work done on dash line path (w_d) $= P\Delta V$

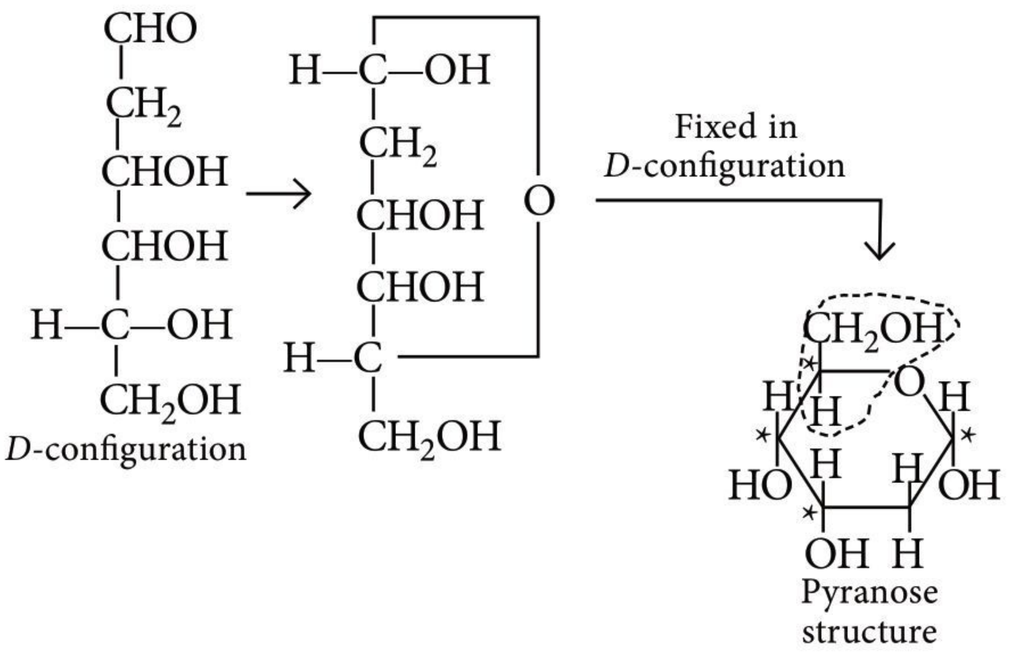
$= 4 \times (2 - 0.5) + 1(3 - 2) + 0.5\,(5.5 - 3)$

$= 6 + 1 + 1.25 = 8.25$

So, $\frac{w_d}{w_s} = \frac{8.25}{4.8} \approx 2$

18. (6)

19. (8) :



Total number of stereoisomers in pyranose form of *D*-configuration = $2^3 = 8$.

PAPER - II

1. (a, c, d) : The crystals of CsCl has *bcc* structure. In such an arrangement the coordination number of both is 8.

In case of NaCl, two interpenetrating *fcc* crystal lattices are present, out of these, two are composed of Na^+ only and the other of Cl^- ions only. Each Na^+ ion is located half-way between two Cl^- ions and each Cl^- ion is located half-way between two Na^+ ions. In a unit cell of NaCl, Cl^- occupy corners as also the face centres and Na^+ ions are located at octahedral voids. On each of a unit cell we have two Cl^- ions and one Na^+ ion. Hence

$a = 2\,(r_{Na^+} + r_{Cl^-}) = 2\,(95 + 181)$ pm $= 552$ pm

2. (a, b, d) : (a) is correct because the plot of $\log K_p$ *vs* $1/T$ is linear.

The expression is $\log K_p = -\dfrac{\Delta H}{R}\cdot\dfrac{1}{T} + I$

It is the expression of a straight line similar to

$y = m\,x + c$

(b) For a first order reaction the plot of $\log [x]$ *vs* time is linear. The expression is

$\log [x] = \log [x_0] + k\,t$

(c) is incorrect because at constant volume we have P/T = constant.

(d) is correct because at constant temperature:

PV = constant [Boyle's law]

3. (a, b, c) : (a) $Na + (x + y)\,NH_3 \longrightarrow$ (excess)

$[Na(NH_3)_x]^+ + e^-(NH_3)_y$

solvated e^-

(Paramagnetic)

(b) $K + O_2 \longrightarrow KO_2$

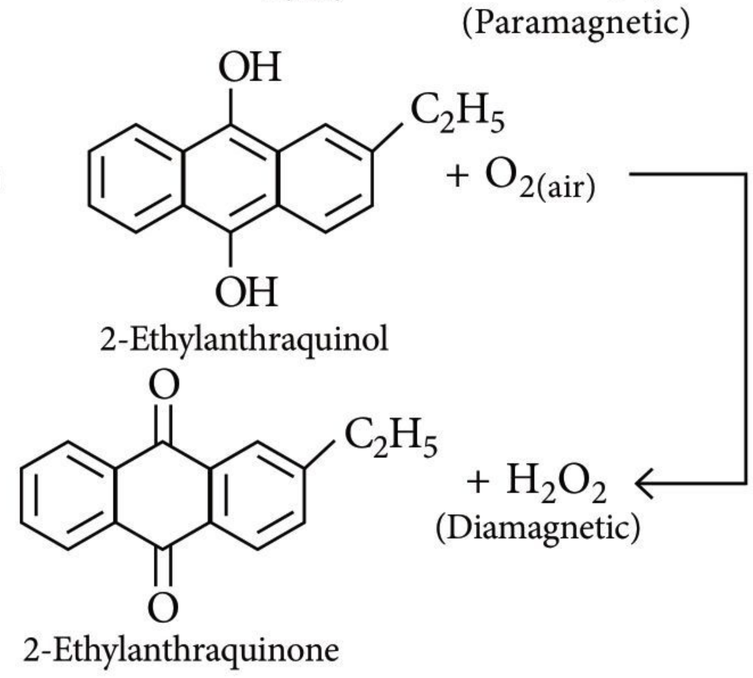
(excess) Potassium superoxide

(Paramagnetic)

(c) $3Cu + 8HNO_{3(dil.)} \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(Paramagnetic)

(d)



4. (b, c, d) : $Mn^{3+} : t_{2g}^4\, e_g^0$

As CN^- is a strong field ligand, therefore complex will be of low spin.

CFSE $= [-0.4(4) + 0.6(0)]\Delta_o + P$

$= -1.6\Delta_o + P = -1.6 \times 38500 + 28000 = -33600\ cm^{-1}$

No. of unpaired electrons in Mn^{3+} in $[Mn(CN)_6]^{3-}$ complex is 2.

Hence $\mu = \sqrt{2(2+2)}$ B.M.

$= 2.83$ B.M.

5. (b, c, d) : (a) $CuFeS_2 + Cu_2S \xrightarrow{\Delta}$ No reaction

(b) $2CuO \xrightarrow{\Delta} Cu_2O + 1/2\ O_2$

(c) $2Cu_2O + Cu_2S \xrightarrow{\Delta} 6Cu + SO_2$

(d) $CuSO_4 \xrightarrow{\Delta} CuO + SO_2 + 1/2\ O_2$

Both CuO and $CuSO_4$ upon heating produces Cu_2O and CuO respectively and further Cu_2O and CuO on heating with Cu_2S gives Cu.

6. (a, c) : As ΔS does not depend on path and only depends on initial and final stages *i.e.*, it is a state function thus

$\Delta S_{X \to Z} = \Delta S_{X \to Y} + \Delta S_{Y \to Z}$

and $\Delta S_{Y \to Z}$ is not zero thus

$\Delta S_{X \to Y \to Z} \neq \Delta S_{X \to Y}$

As we know that work is not a state function and depends on path,

Thus, $w_{X \to Z} \neq w_{X \to Y} + w_{Y \to Z}$

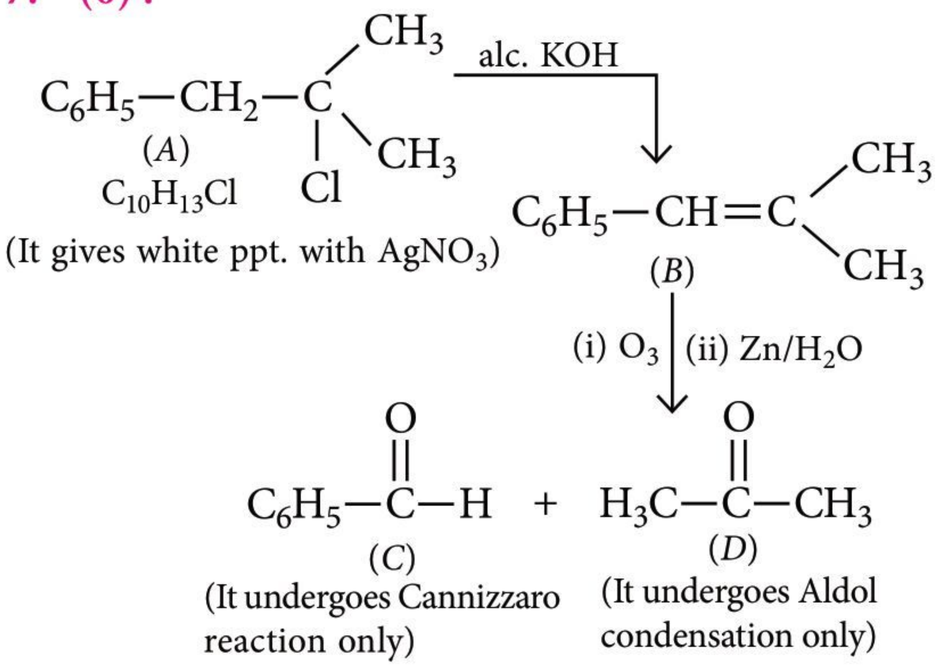
$w_{X \to Y} = PdV$ (P is constant.)

$w_{Y \to Z} = 0$ (V is constant.)

$w_{X \to Y \to Z} = w_{X \to Y} + w_{Y \to Z}$

As $w_{Y \to Z} = 0$, hence $w_{X \to Y \to Z} = w_{X \to Y}$

7. (0) :



8. (7)

9. (0.024) : $A + 2B + 3C \rightleftharpoons AB_2C_3$

6.0 g of A, 6.0×10^{23} atoms of B and 0.036 mol of C yields 4.8 g of compound AB_2C_3.

Atomic mass of A = 60 amu

Atomic mass of C = 80 amu

$$\text{Mole of } A = \frac{6}{60} = \frac{1}{10} = 0.1 \text{ mol}$$

$$\text{Mole of } B = \frac{6.0 \times 10^{23}}{6 \times 10^{23}} = 1 \text{ mol}$$

Mole of C = 0.036 mol

C is the limiting reagent which is consumed completely.

So according to reaction, $A + 2B + 3C \rightleftharpoons AB_2C_3$ with 3 moles of C, 2 moles of B reacts.

So, with 0.036 mol of C, moles of B react

$$= \frac{2}{3} \times 0.036 = 0.024$$

10. (50) : 0.036 mol of C will form $\frac{0.036}{3} = 0.012$ mol of AB_2C_3.

$$\text{Mole of } AB_2C_3 = \frac{\text{Weight}}{\text{Molecular weight}}$$

$$0.012 = \frac{4.8}{\text{Molecular weight of } AB_2C_3}$$

$$\text{So, molecular wt. of } AB_2C_3 = \frac{4.8}{0.012} = 400$$

$\Rightarrow$ Atomic mass of A + 2 × Atomic mass of B + 3 Atomic mass of C = 400

$60 + 2B + 3 \times 80 = 400 \Rightarrow$ Atomic mass of B = 50 amu

11. (1) : $\underset{(M)}{Cu} + 2\underset{(N)}{AgNO_3} \longrightarrow \underset{\text{Light blue}}{Cu(NO_3)_2} + 2Ag$

Cu partially oxidizes to $Cu(NO_3)_2$ and remaining $AgNO_3$ reacts with NaCl.

Cu : $[Ar]3d^{10}\,4s^1$

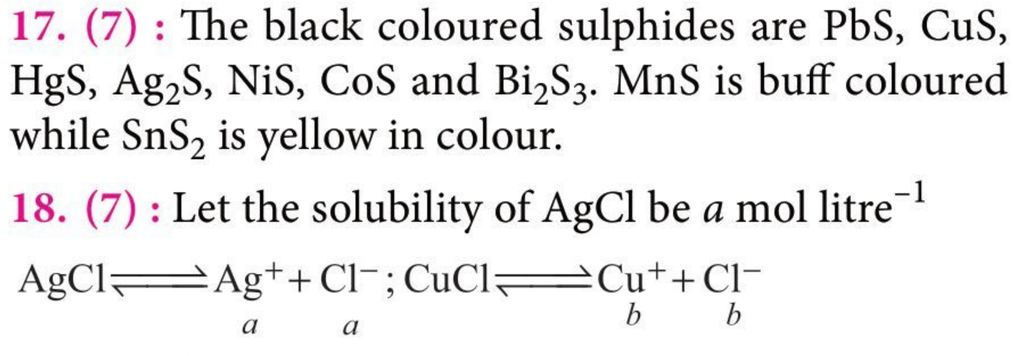
12. (6) : $AgNO_3 + NaCl \longrightarrow AgCl\downarrow + NaNO_3$

$AgCl + 2NH_3 \longrightarrow [Ag(NH_3)_2]^+Cl^-$

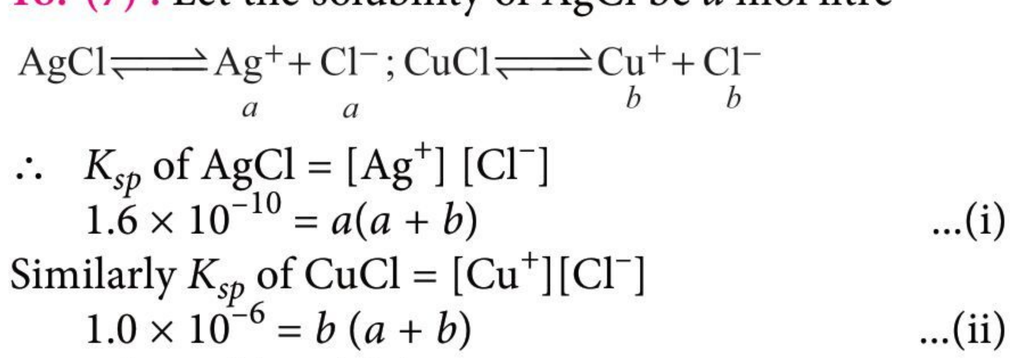
$Cu(NO_3)_2 + 4NH_3 \longrightarrow \underset{\text{Intense blue solution}}{[Cu(NH_3)_4]^{2+}} + 2NO_3^-$

13. (a) **14. (a)**

15. (a) :



16. (d) :



17. (7) : The black coloured sulphides are PbS, CuS, HgS, Ag_2S, NiS, CoS and Bi_2S_3. MnS is buff coloured while SnS_2 is yellow in colour.

18. (7) : Let the solubility of AgCl be a mol litre^{-1}

$$AgCl \rightleftharpoons \underset{a}{Ag^+} + \underset{a}{Cl^-}\,;\; CuCl \rightleftharpoons \underset{b}{Cu^+} + \underset{b}{Cl^-}$$

$\therefore$ K_{sp} of AgCl = $[Ag^+]\,[Cl^-]$

$1.6 \times 10^{-10} = a(a + b)$ ...(i)

Similarly K_{sp} of CuCl = $[Cu^+][Cl^-]$

$1.0 \times 10^{-6} = b\,(a + b)$ ...(ii)

On solving (i) and (ii), we get

$$\frac{a}{b} = 1.6 \times 10^{-4} \quad \text{or} \quad a = 1.6 \times 10^{-4} \times b$$

Substituting the value of a in eq. (i), we get

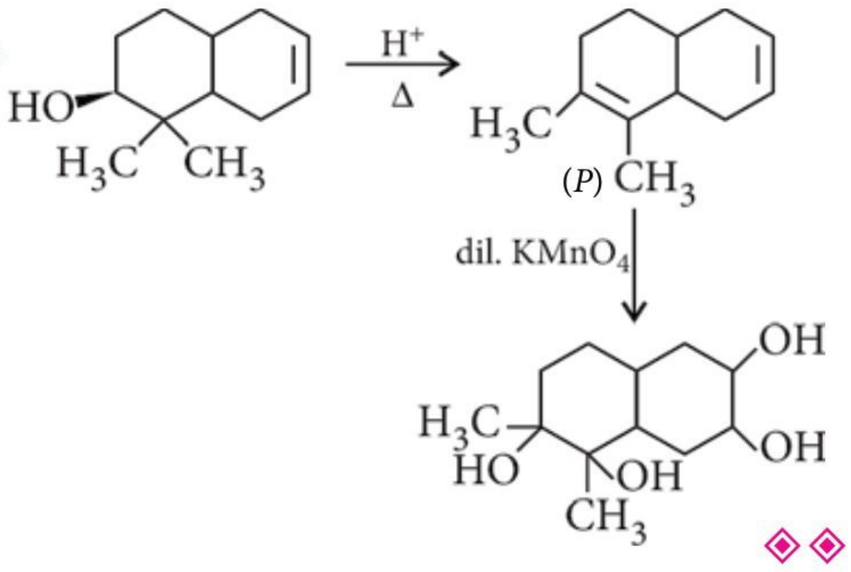
$1.6 \times 10^{-10} = 1.6 \times 10^{-4}\, b\,(1.6 \times 10^{-4}\, b + b)$

$\Rightarrow$ $10^{-6} = b^2\,(1.6 \times 10^{-4} + 1)$ $[\because\ 1.6 \times 10^{-4} <<< 1]$

$\Rightarrow$ $b = 10^{-3} \Rightarrow a = 1.6 \times 10^{-7}$

$[Ag^+] = 1.6 \times 10^{-7}$ M $\quad \therefore \quad x = 7$

19. (4) :



PRACTICE PAPER

NEET 2022

SECTION - A

1. In which of the following, central atom is sp^3 hybridised?
   (a) CH_3^+ (b) NH_4^+ (c) NO_2^+ (d) CO_3^{2-}

2. **Statement-1 :** CH_3OCH_3 and C_2H_5OH have comparable molecular weight but boiling point of C_2H_5OH is more than dimethyl ether.
   Statement-2 : C_2H_5OH forms intermolecular H-bonding while CH_3OCH_3 forms intramolecular H-bonding.
   (a) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1.
   (b) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1.
   (c) Statement-1 is true, Statement-2 is false.
   (d) Statement-1 is false, Statement-2 is true.

3. Among LiCl, RbCl, $BeCl_2$ and $MgCl_2$, the compounds with greatest and least ionic characters respectively are
   (a) LiCl, RbCl (b) RbCl, $BeCl_2$
   (c) RbCl, $MgCl_2$ (d) $MgCl_2$, $BeCl_2$

4. Consider an endothermic reaction $x \rightarrow y$ with the activation energy E_b and E_f for the backward and forward reaction respectively. In general
   (a) $E_b < E_f$ (b) $E_b > E_f$
   (c) $E_b = E_f$
   (d) no definite relation between E_b and E_f.

5. Boiling point and melting point of a hydrocarbon chain can be enhanced by
   (i) increasing number of C-atoms in the chain
   (ii) enhancing branching in hydrocarbon chain
   (iii) increasing substitution of C-chain.
   (a) (i) and (ii) (b) (ii) and (iii)
   (c) (i) and (iii) (d) All of these

6. What is '*A*' in the following reaction (Reaction is not balanced)?
   $Fe^{3+}_{(aq)} + Sn^{2+}_{(aq)} \rightarrow Fe^{2+}_{(aq)} + A$
   (a) $Sn^{3+}_{(aq)}$ (b) $Sn^{2+}_{(aq)}$ (c) $Sn^{4+}_{(aq)}$ (d) Sn

7. The number of lone pair(s) of electrons around Xe in XeO_2F_2 is
   (a) zero (b) 1 (c) 2 (d) 3

8. Which statement apply best to vacuum distillation?
   (a) Distils liquid quickly with decomposition.
   (b) It is very easy to distil.
   (c) Distils liquid to avoid decomposition.
   (d) None of these.

9. The van der Waals' parameters for gases *W*, *X*, *Y* and *Z* are given below :

Gas	a (atm L^2 mol^{-2})	b (L mol^{-1})
W	4.0	0.027
X	8.0	0.030
Y	6.0	0.032
Z	12.0	0.027

   Which one of these gases has the highest critical temperature?
   (a) *W* (b) *X* (c) *Y* (d) *Z*

10. In the reaction
    $$A \xleftarrow{C_2H_5OH} (CH_3)_3CBr \xrightarrow[C_2H_5OH]{C_2H_5O^-Na^+} B$$
    (Major) (Major)
    (a) *A* is $(CH_3)_2C{=}CH_2$ and *B* is $(CH_3)_3COC_2H_5$.
    (b) *A* is $(CH_3)_3COC_2H_5$ and *B* is $(CH_3)_2C{=}CH_2$.
    (c) Both *A* and *B* are $(CH_3)_2C{=}CH_2$.
    (d) Both *A* and *B* are $(CH_3)_3COC_2H_5$.

11. What is the value of *n* in the following half equation?
    $Cr(OH)_4^- + OH^- \rightarrow CrO_4^{2-} + H_2O + ne^-$
    (a) 3 (b) 6 (c) 5 (d) 2

12. The respective oxidation states of iodine in HIO_4, H_3IO_5 and H_5IO_6 are
(a) +1, +3, +7 (b) +7, +7, +7
(c) +3, +3, +3 (d) +7, +5, +3

13. 30 mL of an acid solution is neutralized by 15 mL of a 0.2 N base. The strength of acid solution is
(a) 0.1 N (b) 0.15 N (c) 0.3 N (d) 0.4 N

14. Aldol condensation between which of the following compounds followed by dehydration gives methyl vinyl ketone?
(a) HCHO and CH_3COCH_3
(b) HCHO and CH_3CHO
(c) Two molecules of CH_3CHO
(d) Two molecules of CH_3COCH_3

15. The IUPAC name for $[Pt(py)_4][PtCl_4]$ is
(a) *tetrakis*(pyridine)platinum(II) tetrachloridoplatinate(II)
(b) tetrapyridine tetrachloridodiplatinum(IV)
(c) tetrachlorotetrapyridine diplatinum(II)
(d) *tetrakis*(pyridine)platinum(IV) tetrachloroplatinum(IV).

16. Ionization potential of Na would be numerically the same as
(a) electron affinity of Na^+
(b) electronegativity of Na^+
(c) electron affinity of He
(d) ionization potential of Mg.

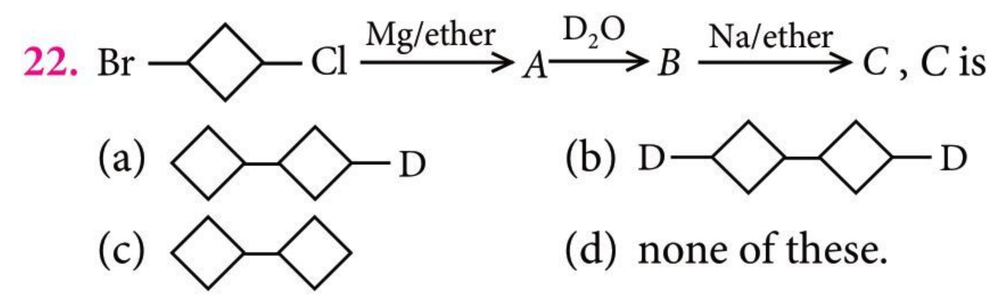
17. $CoCl_{4(aq)}^{2-}$ is blue in colour while $[Co(H_2O)_6]_{(aq)}^{2+}$ is pink. The colour of reaction mixture
$Co(H_2O)_{6(aq)}^{2+} + 4Cl_{(aq)}^{-} \rightleftharpoons CoCl_{4(aq)}^{2-} + 6H_2O_{(l)}$
is blue at room temperature while it is pink when cooled hence
(a) reaction is exothermic
(b) reaction is endothermic
(c) equilibrium will shift in forward direction on adding water to reaction mixture
(d) none of these is correct.

18. Which of the following is ionic solid?
(a) $XeF_{6(s)}$ (b) $PBr_{5(s)}$
(c) $CaC_{2(s)}$ (d) All of these

19. Which is correct about the cyclic silicate $[Si_6O_{18}]^{n-}$?
(a) The value of n is 12.
(b) Each Si atom is bonded with three oxygen atoms.
(c) Each oxygen atom is bonded with two Si atoms.
(d) All of these.

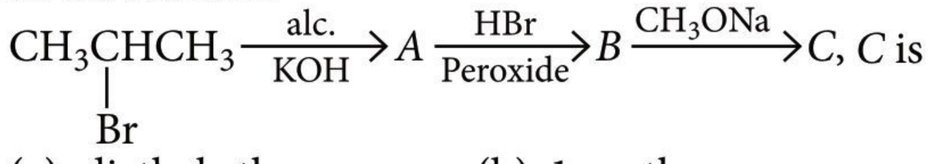
20. When $E^{\circ}_{Ag^+/Ag} = 0.8$ V and $E^{\circ}_{Zn^{2+}/Zn} = -0.76$ V, which of the following is correct?
(a) Ag^+ can be reduced by H_2.
(b) Zn^{2+} can be reduced by H_2.
(c) Ag can reduce Zn^{2+} ion.
(d) All of these.

21. Find out the number of waves made by a Bohr electron in one complete revolution in its 3rd orbit of hydrogen atom.
(a) 4 (b) 3 (c) 6 (d) 8

22.  , C is
(a)
(b)
(c)
(d) none of these.

23. The r.m.s. velocity of hydrogen is $\sqrt{7}$ times the r.m.s. velocity of nitrogen. If T is temperature of the gas then
(a) $T(H_2) = T(N_2)$ (b) $T(H_2) > T(N_2)$
(c) $T(H_2) < T(N_2)$ (d) $T(H_2) = \sqrt{7}\ T(N_2)$.

24. Which of the following is not the characteristic of zinc?
(a) It dissolves in alkali forming sodium zincate.
(b) It is brittle at very high temperatures.
(c) Zinc dust is used as a reducing agent.
(d) All of these.

25. In the reaction

(a) diethyl ether (b) 1-methoxypropane
(c) isopropyl alcohol (d) propylene glycol.

26. A reaction $A \rightarrow B$ follows second order kinetics, doubling the concentration of A will increase the rate of formation of B by a factor of
(a) 2 (b) 1/2 (c) 4 (d) 1/4

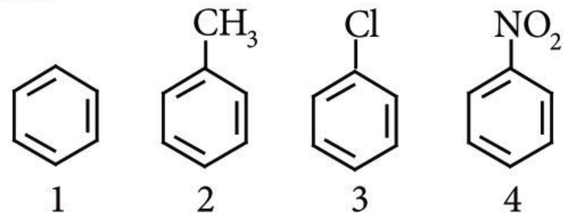
27. Which has maximum covalent character?
(a) NaCl (b) $SiCl_4$ (c) $AlCl_3$ (d) $MgCl_2$

28. Pressure cooker reduces cooking time because
(a) the heat is more evenly distributed
(b) the higher pressure tenderizes the food
(c) the boiling point of water inside is elevated
(d) a larger flame is used.

29. In 300 mL of a 5 volume H_2O_2 sample, what mass of H_2O_2 is there?
(a) 18.2 g (b) 9.1 g
(c) 4.55 g (d) None of these

30. How many gram ions of SO_4^{2-} are present in 1 gram molecule of $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$?
(a) 2 (b) 3 (c) 1 (d) 4

31. Identify the correct order of reactivity in electrophilic substitution reactions of the following compounds.



(a) 1 > 2 > 3 > 4 (b) 4 > 3 > 2 > 1
(c) 2 > 1 > 3 > 4 (d) 2 > 3 > 1 > 4

32. Which is high spin complex ?
(a) $[CoF_6]^{3-}$ (b) $[Fe(CN)_6]^{3-}$
(c) $[Fe(CN)_6]^{4-}$ (d) None of these

33. On heating graphite with conc. HNO_3 repeatedly, a yellow mass is obtained which is called
(a) graphitic acid
(b) graphite peroxide
(c) benzene hexacarboxylic acid
(d) graphitic nitrate.

34. Match the List I with List II and select the correct option.

List I	List II
A. Coagulation	1. Scattering
B. Lyophilization	2. Washing of precipitates
C. Peptization	3. Purification of colloids
D. Tyndall effect	4. Electrolyte

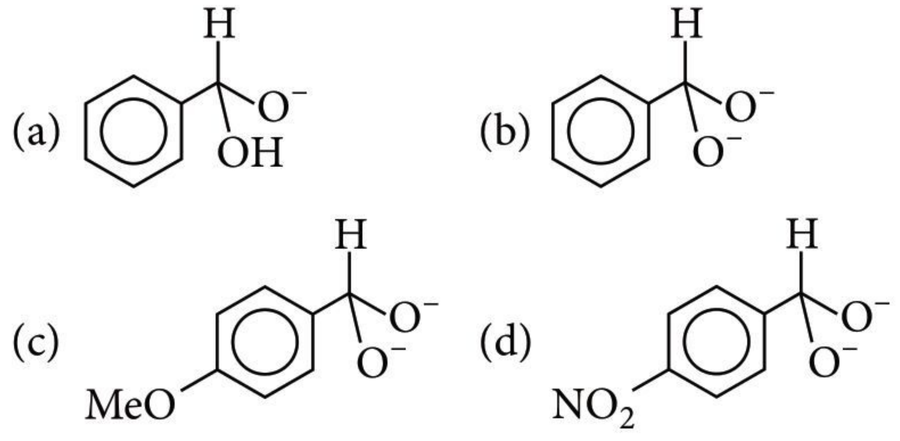
(a) A-4; B-3; C-2; D-1 (b) A-2; B-4; C-3; D-1
(c) A-3; B-1; C-2; D-4 (d) A-4; B-3; C-1; D-2

35. Which of the following processes have positive value for ΔH?
(1) $H_{2(g)} \rightarrow 2H_{(g)}$
(2) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
(3) $H_{(g)} \rightarrow H^+_{(g)} + e^-$
(4) $H_2O_{(l)} \rightarrow H_2O_{(s)}$
(a) 1, 2 and 3 (b) 1 and 2
(c) 2 and 4 (d) 1 and 3

SECTION - B

Attempt any 10 questions out of 15.

36. In a Cannizzaro's reaction the intermediate that will be best hydride donor is

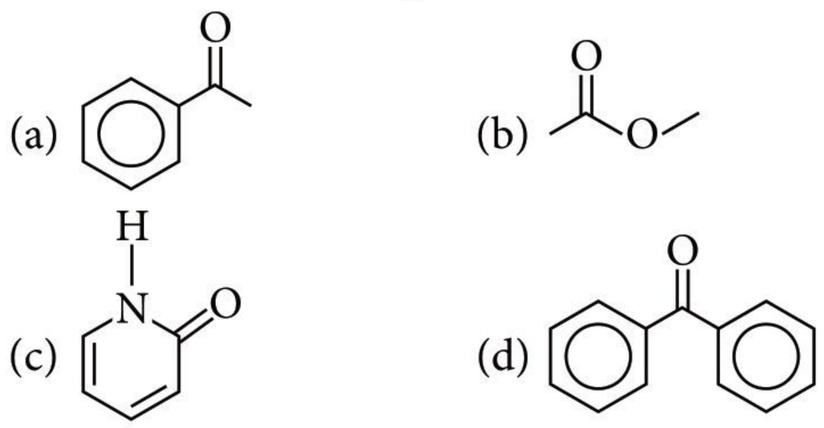


37. Following gaseous reaction is undergoing in a vessel : $C_2H_4 + H_2 \rightleftharpoons C_2H_6$; $\Delta H = -32.7$ kcal
Which will increase the equilibrium concentration of C_2H_6?
(a) Increase in temperature
(b) Reduction in temperature
(c) Removal of some hydrogen
(d) Addition of some C_2H_6

38. Diethylamine reacts with nitrous acid to give
(a) $(C_2H_5)_3NH^+NO_2^-$ (b) $(C_2H_5)_2NNO$
(c) C_2H_5OH (d) N_2 and alcohol.

39. When a solid melts reversibly
(a) ΔH decreases (b) ΔG increases
(c) ΔE decreases (d) ΔS increases.

40. Which of the following will not show tautomerism?



41. At a particular temperature, the vapour pressure of two liquids *A* and *B* are 120 and 180 mm Hg respectively. If 2 moles of *A* and 3 moles of *B* are mixed to form an ideal solution, the vapour pressure (in mm Hg) of solution at same temperature will be
(a) 156 (b) 145 (c) 108 (d) 48

42. In which case, size of chromium is largest?
(a) $K_2Cr_2O_7$ (b) CrO_2Cl_2
(c) $CrCl_3$ (d) All have same size.

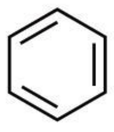
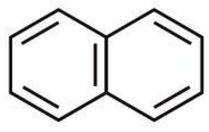
43. Glucose when heated with CH_3OH in presence of dry gas gives α- and β-methyl glucosides because it consists of
(a) an aldehyde group (b) a $—CH_2OH$ group
(c) a ring structure (d) five hydroxyl groups.

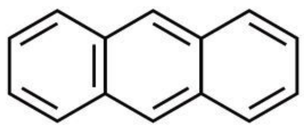
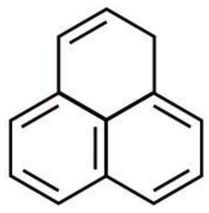
44. Which of the following solution will have pH close to 1.0?
(a) 100 mL of M/10 HCl + 100 mL of M/10 NaOH
(b) 55 mL of M/10 HCl + 45 mL of M/10 NaOH
(c) 10 mL of M/10 HCl + 90 mL of M/10 NaOH
(d) 75 mL of M/5 HCl + 25 mL of M/5 NaOH

45. The role of added sodium cyanide and alkali in the separation of galena from zinc blende and iron sulphide is

(a) to activate (improve) the floating property of PbS
(b) to depress the floating property of ZnS and FeS_2
(c) to act as collector of required ore
(d) to dissolve away ZnS from galena.

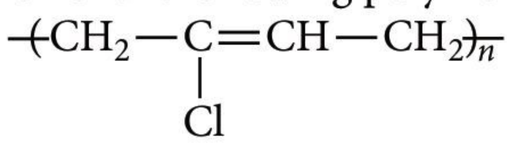
46. By arranging the following molecules in increasing order of σ to π bond ratio, select the correct option.

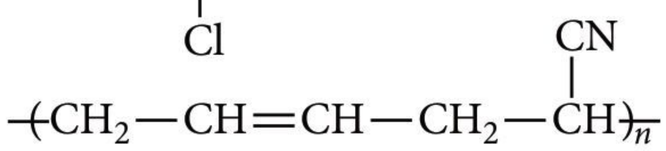
(1)  (2) 

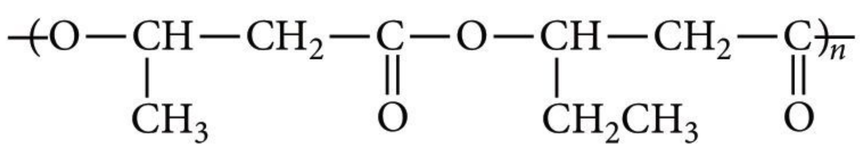
(3)  (4) 

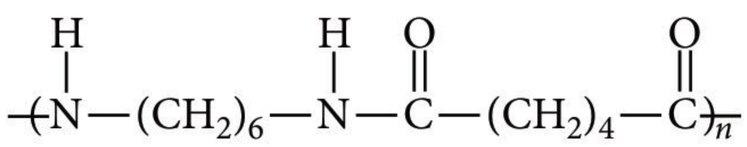
(a) (2) < (3) < (4) < (1) (b) (2) < (4) < (3) < (1)
(c) (3) < (2) < (1) < (4) (d) (2) < (3) < (1) < (4)

47. Which of the following polymers is biodegradable?

(a) 

(b) 

(c) 

(d) 

48. Acid rains are produced by
(a) excess NO_2 and SO_2 from burning fossil fuels
(b) excess production of NH_3 by industry and coal gas
(c) excess release of carbon monoxide by incomplete combustion
(d) excess formation of CO_2 by combustion and animal respiration.

49. *p*-Chloroaniline and anilinium hydrochloride cannot be distinguished by
(a) coupling reaction (b) $NaHCO_3$
(c) $AgNO_3$ (d) carbylamine test.

50. Match the Column I with Column II and select the correct option.

Column I	Column II
(A) Salol	(p) Anaesthetic
(B) Methyl salicylate	(q) Antiseptic
(C) Diethyl ether	(r) Disinfectant
(D) Formaline	(s) Pain balm

(a) A - q ; B - s ; C - q, r ; D - p
(b) A - q ; B - s ; C - p ; D - q, r
(c) A - p ; B - q, r ; C - q ; D - s
(d) A - p ; B - q, r ; C - s ; D - q

SOLUTIONS

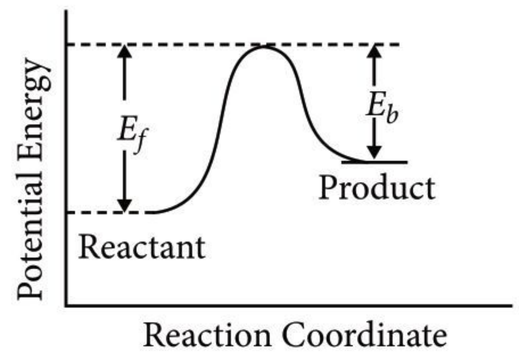
1. (b): NH_4^+, $V = 5$, $M = 4$, $C = 1$, $A = 0$

$H = \frac{1}{2}[5+4-1+0] = 4$, sp^3 hybridization

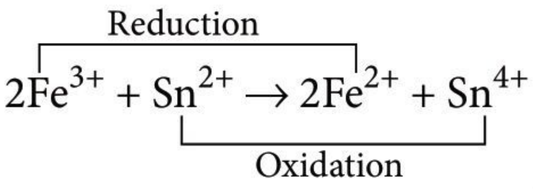
2. (c): Due to the presence of hydroxyl group (—OH), there is extensive hydrogen bonding between the ethanol molecules (C_2H_5OH). But there is no such hydrogen bonding in dimethyl ether (due to absence of —OH group). So, boiling point of dimethyl ether is much lower than ethanol.

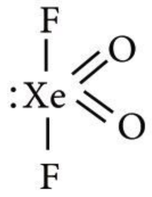
3. (b)

4. (a): In endothermic reaction, reactants absorb energy to get converted into products. From the figure it is clear that $E_b < E_f$.



5. (c): As the number of C-atoms in the chain increases and substitution of C-chain increases, molecular weight also increases, *i.e.*, boiling point and melting point increases.

6. (c): 

7. (b): The structure of XeO_2F_2 is, 

∴ No. of lone pair of electrons on Xe = 1

8. (c): Vacuum distillation is carried out to avoid decomposition of compound.

9. (d): From the given gases, critical temperature of *Z* is highest. This is obtained by using the relation below:

$$T_c = \frac{8a}{27Rb}$$

Higher the value of a/b, higher is the value of T_c.

10. (b): With a weak nucleophile such as C_2H_5OH, substitution takes place to form *tert*-butyl ethyl ether $(CH_3)_3COC_2H_5(A)$. With a strong base like $C_2H_5O^-$, *tert*-butyl bromide undergoes elimination to form $(CH_3)_2C{=}CH_2(B)$.

11. (a): $Cr(OH)_4^- + OH^- \rightarrow CrO_4^{2-} + H_2O$

Writing oxidation states, we have

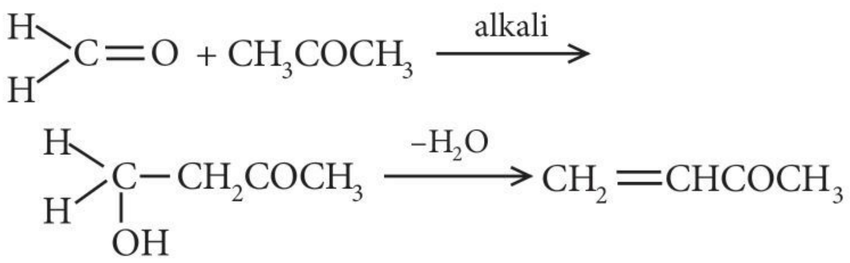
$\overset{+3}{[Cr}(OH)_4]^- + OH^- \rightarrow \overset{+6}{[CrO_4]}^{2-} + H_2O$

To balance oxidation state of Cr on both sides, add $3e^-$ on R.H.S.

12. (b)

13. (a): $N_1V_1 = N_2V_2$; $N_1 \times 30 = 0.2 \times 15$; $N_1 = 0.1$ N
Acid base

14. (a):



15. (a): $[Pt(py)_4][PtCl_4]$:
Tetrakis(pyridine)platinum(II)tetrachloridoplatinate(II)

16. (a): $Na \rightarrow Na^+ + e^-$; *I.E.* of Na = +ve

$Na^+ + e^- \rightarrow Na$; *E.A.* of Na^+ = –ve
Both are equal but opposite in nature.

17. (b): As on cooling pink colour intensifies so reaction is shifting in backward direction, so reaction must be endothermic. On adding water, the equilibrium will shift in the backward direction, as concentration of all species will decrease.

$$K_C = \left(\frac{n_{CoCl_4^{2-}}}{n_{Co(H_2O)_6^{2+}} \times (n_{Cl^-})^4} \right) (\text{volume})^4$$

18. (d): All are ionic solids.

$XeF_{6(s)}$ consists of XeF_5^+ and F^- ions.

$PBr_{5(s)}$ consists of PBr_4^+ and Br^- ions.

$CaC_{2(s)}$ consists of Ca^{2+} and C_2^{2-} ions.

19. (a): General formula of cyclic silicates is $[SiO_3]_n^{2n-}$.

20. (a): Silver has higher reduction potential and can be easily reduced by H_2.

21. (b): We know that $r_n = r_0 \times n^2$

$\therefore \quad r_3 = 0.529 \times 10^{-8}\text{cm} \times (3)^2$ ($\because r_0 = 0.529 \times 10^{-8}$ cm)
Also we know that

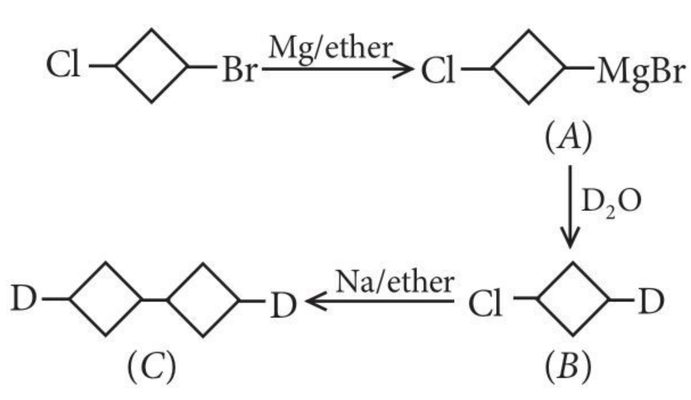
$$u_n = \frac{u_0}{n} \quad \therefore \; u_3 = \frac{2.19 \times 10^8}{3} \; (\because \; u_0 = 2.19 \times 10^8 \text{ cm sec}^{-1})$$

$$\text{No. of waves in one round} = \frac{2\pi r_3}{\lambda} = \frac{2\pi r_3}{h/mu_3} = \frac{2\pi r_3 \times u_3 \times m}{h}$$

Substituting the values of the different constants.
No. of waves in one round

$$\frac{2 \times 3.14 \times 0.0529 \times 10^{-8} \times 9 \times 2.19 \times 10^8 \times 9.108 \times 10^{-28}}{3 \times 6.62 \times 10^{-27}} = 3$$

22. (b):

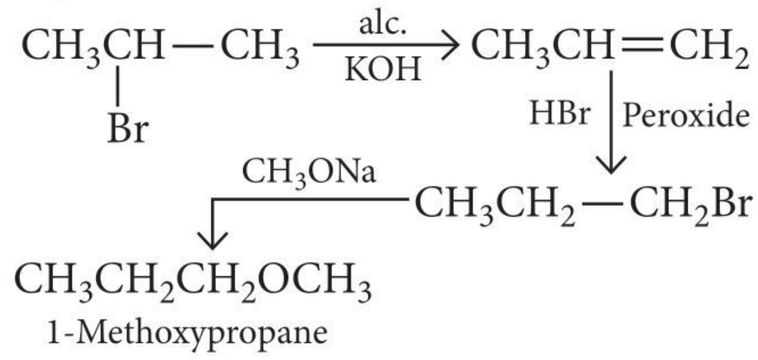


23. (c): $C_{rms} = \sqrt{\frac{3RT}{M}}$; $\frac{C_{rms}(H_2)}{C_{rms}(N_2)} = \sqrt{\frac{T(H_2)}{M(H_2)} \times \frac{M(N_2)}{T(N_2)}}$

$$\sqrt{7} = \sqrt{\frac{T(H_2)}{T(N_2)} \times \frac{28}{2}} \quad \text{or,} \quad \frac{T(H_2)}{T(N_2)} = \frac{1}{2}$$

24. (b): Zinc is brittle at ordinary temperature but not at high temperature.

25. (b):



26. (c): Rate law, rate $r_1 = k\,[A]^2$
On doubling the concentration rate $r_2 = k[2A]^2 = 4k[A]^2$
i.e., rate increases by 4 times, $r_2 = 4r_1$.

27. (b): Polarisation in the molecule increases with increase of charge and decreases in size of the cation when the anion is same.

28. (c): Pressure cooker increases the boiling point of water inside.

29. (c): 5 volume H_2O_2 means 3.035×5 g per litre which is 15.175 g per litre. Amount present in 300 mL is $\frac{300}{1000} \times 15.175 = 4.55$ g.

30. (d): 1 g molecule is 1 mole.
Mole of $SO_4^{2-} = 4 \times 1 = 4$ g ion.

31. (c)

32. (a): F^-, being weak field ligand, results in high spin complex.

33. (a): When treated with conc. HNO_3, graphite is oxidised to insoluble yellowish green substance known as graphitic acid, $C_{11}H_4O_5$.

34. (a):

Coagulation	:	Electrolyte
Lyophilization	:	Purification of colloids
Peptization	:	Washing of precipitates
Tyndall effect	:	Scattering

35. (d): (1) $H_{2(g)} \rightarrow 2H_{(g)}$. It involves breaking of bond between H—H which needs energy.
$\therefore \quad \Delta H$ = +ve

(2) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$. It involves bond formation which results in release of energy.
$\therefore \quad \Delta H$ = –ve

(3) $H_{(g)} \rightarrow H^+_{(g)} + e^-$
This is ionization, which needs energy. $\therefore \quad \Delta H$ = +ve

(4) $H_2O_{(l)} \rightarrow H_2O_{(s)}$. Phase transformation from $(l) \rightarrow (s)$. It involves cooling. Hence, ΔH = –ve

$\therefore$ (d) is correct answer.

36. (d)

37. (b): Exothermic reaction is favoured at low temperature.

38. (b): $(C_2H_5)_2NH + HONO \rightarrow (C_2H_5)_2N—N=O + H_2O$

39. (d): When a solid melts, it changes into liquid and hence, entropy (S) increases.

40. (d)

41. (a): $P_{Total} = p_A + p_B = p_A^\circ X_A + p_B^\circ X_B$

$$= 120 \times \frac{2}{2+3} + 180 \times \frac{3}{2+3} = 156 \text{ mm of Hg}$$

42. (c) **43. (c)**

44. (d): (a) 100 mL of M/100 HCl complete neutralises 100 mL of M/10 NaOH. Hence pH = 7.

(b) After neutralisation, M/10 HCl left = 10 mL

Total volume = 100 mL, Dilution = 10 times

$\therefore$ $[H^+] = 10^{-2}$ or pH = 2

(c) After neutralisation, M/10 NaOH left = 80 mL

Total volume = 100 mL, pH > 7

(d) After neutralisation, M/5 HCl left = 50 mL

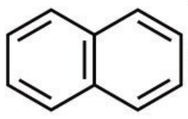
Total volume = 100 mL, Dilution = 2 times

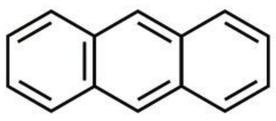
$\therefore$ $[H^+] = 1/10 = 10^{-1}$ or pH = 1.

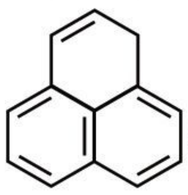
Thus, (d) is correct option.

45. (b): By depressing the floating property of ZnS and FeS_2, galena alone is carried up in the froth.

46. (c): (1)  ; $12\sigma, 3\pi \Rightarrow 12/3 = 4$

(2)  ; $19\sigma, 5\pi \Rightarrow 19/5 = 3.8$

(3)  ; $26\sigma, 7\pi \Rightarrow 26/7 = 3.71$

(4)  ; $25\sigma, 6\pi \Rightarrow 25/6 = 4.166$

47. (c) **48. (a)**

49. (d): *p*-Chloroaniline gives coupling reaction with benzene diazonium chloride. Due to the absence of lone pair of electrons on the N-atom, coupling reaction does not occur with anilinium hydrochloride. Anilinium hydrochloride is an acid salt and therefore, liberates CO_2 with $NaHCO_3$ and gives white ppt. of AgCl with $AgNO_3$. However, both are primary amines and give carbylamine test and therefore, cannot be distinguished.

50. (b)

For the SCIENTIST in YOU

Combining and automating two key steps in water analysis could help keep drinking water supplies safe!!

Water is vital for life, but it can carry many dissolved substances that can be harmful. The levels of some potentially harmful chemicals in water samples can now be determined more quickly and effectively using an automated method reported in the open access journal *Talanta Open*.

The technology, developed by researchers in the United States, is specifically focused on detecting chemicals containing bromine, chlorine and iodine, in addition to the total content of metallic elements. Some of these chemicals are of significant concern. For example, bromide ions (Br^-) that are naturally present in water can be converted into bromate ions (BrO_3^-) during ozonation or chlorination disinfection treatment. Bromate has been identified as a potential carcinogen. Iodine and chlorine can also be converted into harmful by-products of disinfection.

"Our method is unique in that it saves a tremendous amount of time by combining what are normally two separate methods into one automated step," says researchers from Elemental Scientific worked on the system together with Perkin Elmer Inc.

The two methods that are combined involve processes known as chromatography – specifically a sophisticated procedure called prepFAST IC – and inductively-coupled plasma mass spectrometry (ICP-MS).

Chromatography separates the chemicals in a sample based on the different rates at which they flow through a column of stationary material when carried by a mobile phase, in this case a liquid. The ICP-MS stage then identifies chemical species present based on their different masses.

A key incentive leading to the development of this faster automated procedure was the concern that the processes used to disinfect drinking water supplies lead to potentially harmful by-products of the disinfection. These must be monitored routinely to ensure the safety of the water supply.

To prove the efficacy of their system the team analysed samples of water from rivers and lakes that were used as sources of domestic water supplies, and also residential tap water. The results revealed some "interesting differences" between the levels of contaminants of concern in tap water from different countries surrounding Atlanta, Georgia. The researchers attributed some of these differences to differing effects of the water treatment procedures in the countries.

Local differences in plumbing fixtures were a possible cause of differing results for metal ion contamination.

The proof-of-concept trials also revealed that combining the two separate analytical stages into one, plus automating the initial dilution step, could bring useful increases in sensitivity in addition to the increased speed and ease of operation.

the technology may be suitable for continuous monitoring at water treatment facilities, as an improvement on the common current practice of taking samples at intervals.

CUET (UG)

PRACTICE PAPER 2022

Section II of CUET (UG) is Domain specific. In this section of Chemistry 40 questions to be attempted out of 50.

Max. Marks : 200 Marks

Time : 45 minutes

Multiple Choice Questions (MCQs)

1. Bredig arc method cannot be used to prepare colloidal solution of which of the following metal?
(a) Pt (b) Fe (c) Ag (d) Au

2. Which of the following reagent cannot be used to distinguish between phenol and benzyl alcohol?
(a) NaOH (b) $NaHCO_3$
(c) Br_2/CCl_4 (d) $FeCl_3$

3. In the following sequence of reactions,

$$CH_3CH_2CH_2I \xrightarrow{KOH\ (alc.)} (A) \xrightarrow[CCl_4]{Br_2} (B)$$

$$(C) \xleftarrow{2NaNH_2/NH_3}$$

The end product (*C*) is
(a) alkene (b) alkanol
(c) alkyne (d) alkyl amine.

4. A mixture of benzaldehyde and formaldehyde on heating with conc. NaOH solution gives
(a) benzyl alcohol and sodium formate
(b) sodium benzoate and methyl alcohol
(c) sodium benzoate and sodium formate
(d) benzyl alcohol and methyl alcohol.

5. A solid is made of two elements *X* and *Z*. The atoms *Z* are in CCP arrangement while the atom *X* occupy all the tetrahedral sites. What is the formula of the compound?
(a) *XZ* (b) XZ_2 (c) X_2Z (d) X_2Z_3

6. The set with correct order of acidity is
(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO_3 < HClO_2 < HClO$
(c) $HClO < HClO_4 < HClO_3 < HClO_2$
(d) $HClO_4 < HClO_2 < HClO_3 < HClO$

7. Half-life of a reaction is found to be inversely proportional to the cube of initial concentration. The order of reaction is
(a) 4 (b) 3 (c) 5 (d) 2

8. Amongst the given set of reactants, the most appropriate for preparing 2° amine is _____.
(a) 2° *R*—Br (1 mol) + NH_3
(b) 2° *R*—Br + NaCN followed by H_2/Pt
(c) 1° *R*—NH_2 + *R*CHO followed by H_2/Pt
(d) 1° *R*—Br (2 mol) + potassium phthalimide followed by H_3O^+/heat

9. Which of the following statements is not correct regarding vinylic polymerisation?
(a) It involves free radical addition.
(b) The presence of carbon tetrachloride in styrene polymerisation results in lowering of average molecular mass of the polymer.
(c) The presence of benzoquinone increases the polymerisation process.
(d) The presence of CCl_4 acts as inhibitor.

10. In A^+B^- ionic compound, radii of A^+ and B^- ions are 180 pm and 187 pm respectively. The crystal structure of this compound will be
(a) NaCl type (b) CsCl type
(c) ZnS type (d) similar to diamond.

11. Ammonia gas can be dried over
(a) $CaCl_2$ (b) conc. H_2SO_4
(c) PCl_5 (d) quick lime.

12. Which of the following statements is correct?
(a) A polymer of α-glucose is readily digested by human beings and not that of β-glucose.
(b) A polymer of β-glucose is readily digested by human being and not that of α-glucose.
(c) Polymers of both α-and β-glucoses are readily digested by human beings.
(d) Polymers of both α- and β-glucose are not readily digested by human beings.

13. A catalyst lowers the activation energy of the forward reaction by 10 kJ mol^{-1}. What effect does it have on the activation energy of the backward reaction?

(a) Increases by 10 kJ mol^{-1}
(b) Decreases by 10 kJ mol^{-1}
(c) Remains unaffected
(d) Cannot be predicted

14. Under which of the following reaction conditions, aniline gives *p*-nitro derivative as the major product?

I. Acetyl chloride/pyridine followed by reaction with conc. H_2SO_4 + conc. HNO_3.
II. Acetic anhydride/pyridine followed by conc. H_2SO_4 + conc. HNO_3.
III. Dil. HCl followed by reaction with conc. H_2SO_4 + conc. HNO_3.
IV. Reaction with conc. HNO_3 + conc. H_2SO_4.

(a) Only I (b) Both I & II
(c) Only III (d) Both II & IV

15. For 0.1 M solution, the colligative property will follow the order

(a) $NaCl > Na_2SO_4 > Na_3PO_4$
(b) $NaCl < Na_2SO_4 < Na_3PO_4$
(c) $NaCl > Na_2SO_4 \approx Na_3PO_4$
(d) $NaCl < Na_2SO_4 = Na_3PO_4$

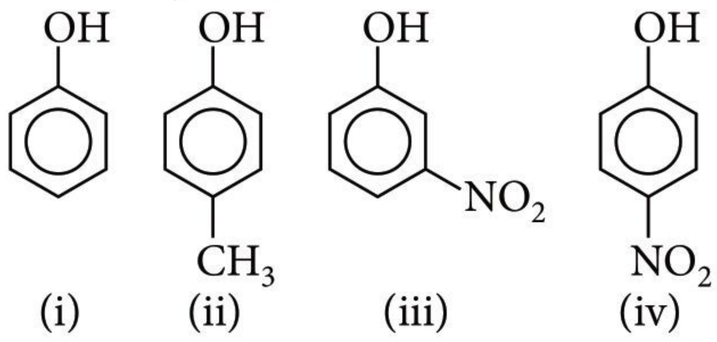
16. When MnO_2 is fused with KOH in the presence of air, a coloured compound is formed, the product and its colour is

(a) K_2MnO_4, dark green
(b) $KMnO_4$ purple
(c) Mn_2O_3, brown
(d) Mn_3O_4, black.

17. Which of the following processes is used in the extractive metallurgy of magnesium?

(a) Fused salt electrolysis
(b) Self reduction
(c) Aqueous solution electrolysis
(d) Thermite reduction

18. In the following compounds :



The order of acidity is

(a) (iii) > (iv) > (i) > (ii)
(b) (i) > (iv) > (iii) > (ii)
(c) (ii) > (i) > (iii) > (iv)
(d) (iv) > (iii) > (i) > (ii)

19. Calculate the order of reaction, $A \rightarrow$ Product, from the following data :

[*A*] (moles/ L)	*d* [Product]/ *dt* (moles/ L/ sec)
0.003	10.0×10^{-5}
0.006	5.0×10^{-5}
0.012	2.5×10^{-5}

(a) 1 (b) –2 (c) –1 (d) 2

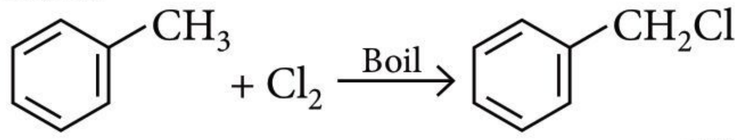
20. Why is HCl not used to make the medium acidic in oxidation reactions of $KMnO_4$ in acidic medium?

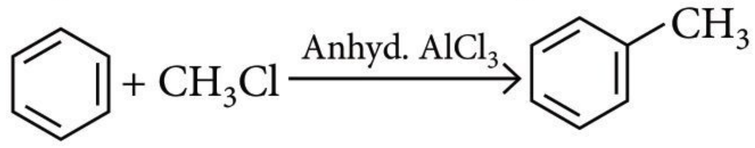
(a) Both HCl and $KMnO_4$ act as oxidising agents.
(b) $KMnO_4$ oxidises HCl into Cl_2 which is also an oxidising agents.
(c) $KMnO_4$ is a weaker oxidising agent than HCl.
(d) $KMnO_4$ acts as a reducing agent in the presence of HCl.

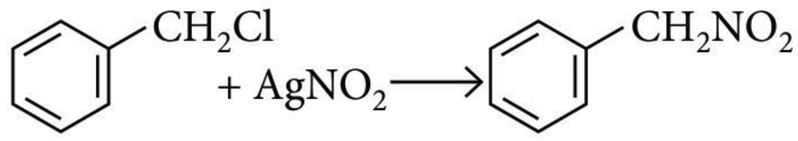
21. Hydrolysis of proteins in the presence of enzymes produces

(a) hydroxy acids (b) dicarboxylic acids
(c) amino acids (d) aromatic acids.

22. Which of the following is a free radical substitution reaction?

(a) 

(b) 

(c) 

(d) $CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$

23. Which of the following is incorrect in a galvanic cell?

(a) Oxidation occurs at anode.
(b) Reduction occurs at cathode.
(c) The electrode at which electrons are gained is called cathode.
(d) The electrode at which electrons are lost is called cathode.

24. The complex ion which has no '*d*' electrons in the central metal atom is

(a) $[MnO_4]^-$ (b) $[Co(NH_3)_6]^{3+}$
(c) $[Fe(CN)_6]^{3-}$ (d) $[Cr(H_2O)_6]^{3+}$

25. The products obtained when benzyl phenyl ether is heated with HI in the mole ratio 1 : 1 are

I. phenol II. benzyl alcohol
III. benzyl iodide IV. iodobenzene.
(a) I and III only (b) III and IV only
(c) I and IV only (d) II and IV only.

26. Which of the following statements about a catalyst is true?
(a) It lowers the energy of activation.
(b) The catalyst altered during the reaction is regenerated.
(c) It does not alter the equilibrium.
(d) All of these.

27. Which of the following compounds is expected to be coloured?
(a) Ag_2SO_4 (b) CuF_2 (c) MgF_2 (d) CuCl

28. During depression of freezing point in a solution the following are in equilibrium
(a) liquid solvent, solid solvent
(b) liquid solvent, solid solute
(c) liquid solute, solid solute
(d) liquid solute, solid solvent.

29. Point defects are present in
(a) molecular solids (b) amorphous solids
(c) liquids (d) ionic solids.

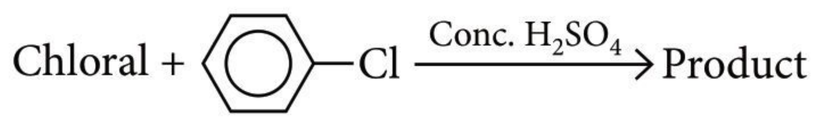
30. Which of the following complexes are homoleptic?
I. $[Co(NH_3)_6]^{3+}$ II. $[Co(NH_3)_4Cl_2]^{+}$
III. $[Ni(CN)_4]^{2-}$ IV. $[Ni(NH_3)_4Cl_2]$
(a) I & III (b) II & III
(c) III & IV (d) I, II & III

31. The two structure of *D*-glucopyranose forms are
(a) enantiomers (b) anomers
(c) epimer (d) geometrical isomers.

32. Which of the following reactions is used in thermite welding?
(a) $TiO_2 + 4Na \longrightarrow Ti + 2Na_2O$
(b) $Cr_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Cr$
(c) $3Mn_3O_4 + 8Al \longrightarrow 4Al_2O_3 + 9Mn$
(d) $2Al + Fe_2O_3 \longrightarrow Al_2O_3 + 2Fe$

33. Which of the following is not true?
(a) Some disinfectants can be used as antiseptics.
(b) Sulphadiazine is a synthetic antibacterial.
(c) Aspirin is analgesic as well as antipyretic.
(d) Polystyrene is used to make non-stick cookware.

34. The reaction between chloral and chlorobenzene in the presence of concentrated H_2SO_4 is given as



The product is
(a) lindane (b) DDT
(c) teflon (d) ethane perchlorate.

Assertion & Reason Based MCQs

For question numbers 35-38, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.
(a) If both assertion and reason are correct and reason is the correct explanation of assertion.
(b) If both assertion and reason are correct but reason is not the correct explanation of assertion.
(c) If assertion is correct but reason is wrong.
(d) If assertion is wrong but reason is correct.

35. **Assertion :** The highest oxidation state of osmium is +8.
Reason : Osmium is a 5*d*-series element.

36. **Assertion :** Physical adsorption of molecules takes place on surface only.
Reason : In this process, multimolecular layers are formed.

37. **Assertion :** F—F bond in F_2 molecule is strong.
Reason : F atom is small in size.

38. **Assertion :** Carbylamine reaction involves the reaction between 1° amine and chloroform in the presence of alkali.
Reason : In carbylamine reaction, $-NH_2$ group changes to —NC group.

Match the Column

39. Match the complexes in Column I with their properties listed in Column II and select the correct option.

Column I	Column II
(A) $[Co(NH_3)_4(H_2O)_2]Cl_2$	(p) Geometrical isomers
(B) $[Pt(NH_3)_2Cl_2]$	(q) Paramagnetic
(C) $[Co(H_2O)_5Cl]Cl$	(r) Diamagnetic
(D) $[Ni(H_2O)_6]Cl_2$	(s) Metal ion with +2 oxidation state

(a) A - p,q,s ; B - p,r,s ; C - q,s ; D - q,s
(b) A - p,q,s ; B - p,r,s ; C - r ; D - r
(c) A - p,r ; B - p,r ; C - q,s ; D - q,s
(d) A - p,r ; B - p,q,r ; C - q,s ; D - q,s

40. Match the polymers in Column I with the characteristic listed in Column II and select the correct option.

Column I	Column II
(A) Buna-S	(p) Synthetic polymer
(B) Bakelite	(q) Biodegradable polymer
(C) Teflon	(r) Elastomer
(D) Polylactic acid	(s) Thermoplastic

(a) A - p,r ; B - q,r ; C - p,s ; D - p
(b) A - p,r ; B - p ; C - p,s ; D - q
(c) A - q,r ; B - p ; C - p,s ; D - q
(d) A - q,r ; B - q ; C - p,s ; D - r

Case Based MCQs

Case I : Read the passage given below and answer the following questions from 41 to 45.

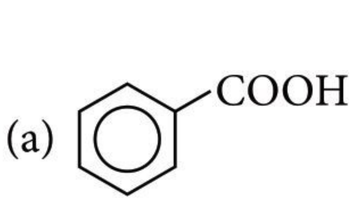
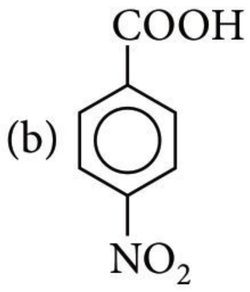
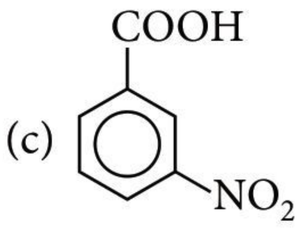
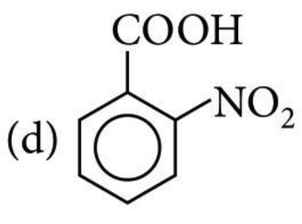
Carboxylic acids are distinctly acidic because they ionise in water to give hydronium ions as:

$RCOOH + H_2O \rightleftharpoons RCOO^- + H_3O^+$

The acidic strength depends upon the extent of ionization of the acid and the stability of the anion formed. The acidic strength can also be expressed in terms of dissociation constant K_a or pK_a which are related as $pK_a = -\log K_a$.

The substituents have marked effect on the acidic strength of carboxylic acids. Any group which stabilises the carboxylate ion more than the carboxylic acid group will increase the acidic strength and the group which de-stabilises the carboxylate group more than the carboxylic acid group will decrease the acidic strength. In a similar manner, the electron releasing groups make benzoic acid weaker while electron withdrawing groups make benzoic acid stronger. The *ortho* isomer of every substituted benzoic acid (whether electron releasing or electron withdrawing) is the strongest among the three isomers due to *ortho* effect.

41. Which of the following is weakest acid?

(a) 
(b) 
(c) 
(d) 

42. Which of the following orders of relative strengths of acids is correct?
(a) $FCH_2COOH > ClCH_2COOH > BrCH_2COOH$
(b) $ClCH_2COOH > BrCH_2COOH > FCH_2COOH$
(c) $BrCH_2COOH > ClCH_2COOH > FCH_2COOH$
(d) $ClCH_2COOH > FCH_2COOH > BrCH_2COOH$

43. Which of the following statements is not correct ?
(a) Chloroacetic acid is stronger acid than acetic acid.
(b) Formic acid is stronger acid than isobutyric acid.
(c) 3-Chlorobutanoic acid is weaker acid than 4-Chlorobutanoic acid.
(d) Phenols are weaker acids than carboxylic acids.

44. Which of the following decreasing order of acid strength of
I. Methanoic acid II. Ethanoic acid
III Propanoic acid IV. Butanoic acid
is correct?
(a) I > II > III > IV (b) IV > III > II > I
(c) I > IV > III > II (d) IV > I > II > III.

45. The pK_a of acetyl salicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about 2.3 and pH in the small intestine is about 8. Aspirin will be
(a) completely ionized in the stomach and almost unionized in the small intestine
(b) ionized in the stomach and almost ionized in the small intestine
(c) unionized in the stomach and in the small intestine
(d) ionized in the small intestine and almost unionized in the stomach.

Case II : Read the passage given below and answer the following questions from 46 to 50.

The process of electrolysis is carried out by taking the solution of an electrolyte in a suitable vessel. The vessel is called electrolytic tank. It is made up of either glass or of a material which is a bad conductor of electricity. Two metallic rods or plates are suspended in the electrolytic solution. These are connected to the terminal of a battery with the help of metallic wires. These metallic rods or plates allow the passage of current and are called electrolytes. The electrode connected to the positive terminal of the battery is called anode while the electrode connected to the negative terminal of the battery is called cathode.

46. The amount of ion discharged during electrolysis is not directly proportional to
(a) resistance (b) time
(c) current
(d) chemical equivalent of the ion.

47. Electrolysis of dilute aqueous NaCl solution was carried out by passing 10 milli ampere current. The time required to liberate 0.01 mol of H_2 gas at the cathode is (1 Faraday = 96500 C mol^{-1})

(a) 9.65×10^4 sc (b) 19.3×10^4 sec
(c) 28.95×10^4 sec (d) 38.6×10^4 sec

48. The platinum electrodes were immersed in a solution of cupric sulphate and electric current is passed through the solution. After sometime it was found that colour of copper sulphate disappeared with evolution of gas at the electrode. The colourless solution contains
(a) platinum sulphate (b) copper hydroxide
(c) copper sulphate (d) sulphuric acid.

49. 2.5 Faraday of electricity is passed through solution of $CuSO_4$. The number of gram equivalents of copper deposited on the cathode would be
(a) 1 (b) 2 (c) 2.5 (d) 1.25

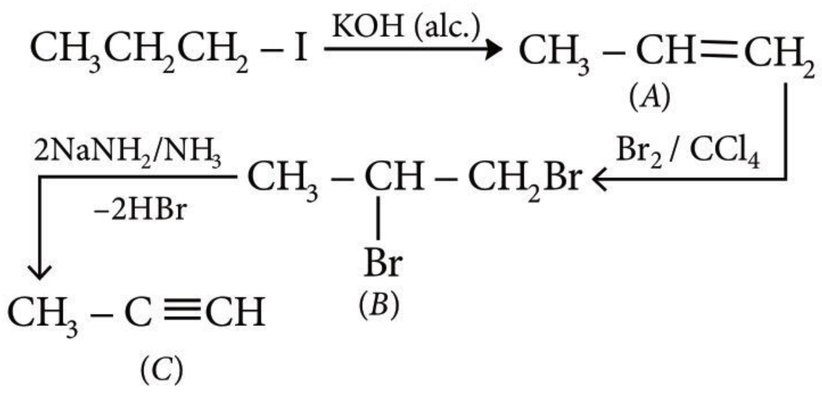
50. In electrolysis of a fused salt, the weight of the deposit on an electrode will not depend on
(a) temperature of the bath
(b) current intensity
(c) electrochemical equivalent of ions
(d) time for electrolysis.

SOLUTIONS

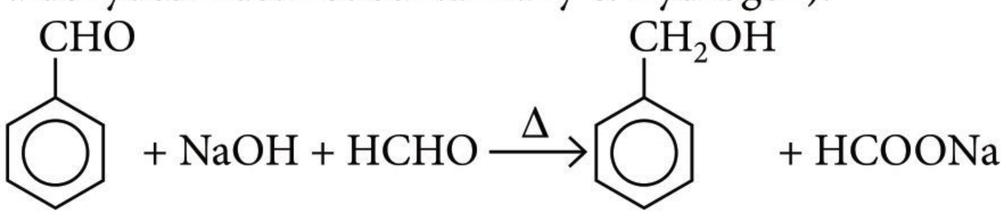
1. (b): Bredig's arc method is suitable for the preparation of colloidal solution of metals like gold, silver, platinum etc. An arc is struck between the metal electrode under the surface of water containing some stabilizing agent such as a trace of KOH. However, Fe does not react with alkalies that is why it is not obtained by Bredig's arc method.

2. (b)

3. (c):



4. (a): It is an example of cross Cannizaro reaction where aromatic aldehyde get reduced to alcohol and aliphatic aldehyde gets oxidised to its salt (both aldehydes must not contain any α-hydrogen).



5. (c): Tetrahedral sites are double to the number of atoms in a unit cell, So, the ratio of X and Z is 2 : 1. Thus, the formula of the compound X_2Z.

6. (a): The acidic character of oxoacids increases with increasing oxidation number of central halogen.

$HXO_4 > HXO_3 > HXO_2 > HXO$.

Because 'H' atom is bonded with oxygen atom and increasing oxidation number of central halogen increases the stability of X—O bond of anion, and weakens the strength of O—H therefore increases acidic character.

7. (a): $t_{1/2} \propto [A_0]^{1-n}$ given, $t_{1/2} \propto [A_0]^{-3}$

Then, $n = 4$, *i.e.*, order of reaction = 4.

8. (c) **9. (c)**

10. (b): $r_+ / r_- = \frac{180}{187} = 0.962$ which lies in the range of 0.732 – 1.000, hence co-ordination number = 8 *i.e.*, the structure is CsCl type.

11. (d): Because quick lime is basic in nature, so it will not react with NH_3.

12. (a)

13. (b): Catalyst brings the equilibrium faster by decreasing the activation energy for both forward and backward reaction.

14. (b)

15. (b): Colligative property in decreasing order
$Na_3PO_4 > Na_2SO_4 > NaCl$

$Na_3PO_4 \rightarrow 3\ Na^+ + PO_4^{3-}$ = 4 ions

$Na_2SO_4 \rightarrow 2\ Na^+ + SO_4^{2-}$ = 3 ions

$NaCl \rightarrow Na^+ + Cl^-$ = 2 ions

16. (a): $2MnO_2 + 4KOH + O_2 \rightarrow \underset{\text{(dark green)}}{2K_2MnO_4} + 2H_2O$

17. (a) : Extraction of Mg is usually done by the electrolysis of fused oxide or fused anhydrous $MgCl_2$ because of its reactive nature.

$MgCl_2 \rightarrow Mg^{2+} + 2Cl^-$

At cathode : $Mg^{2+} + 2e^- \rightarrow Mg$

At anode : $2Cl^- \rightarrow 2e^- + Cl_2$

18. (d): Phenol is more acidic than cresol but less acidic than nitrophenol. *p*-nitrophenol is more acidic than *m*-nitrophenol. Then the correct order is
p-nitrophenol > *m*-nitrophenol > phenol > cresol.

19. (c) : From 1st reading

rate = $10.0 \times 10^{-5} = k\ [0.003]^n$ ....(i)

(where, n is order of reaction)

From 2nd reading

rate = $5.0 \times 10^{-5} = k\ [0.006]^n$ ....(ii)

Dividing (*i*) by (*ii*),

$\therefore \quad n = -1$.

20. (b)

21. (c) : Hydrolysis of proteins in presence of enzymes produces amino acids.

22. (a): Side chain chlorination takes place by free radical substitution mechanism.

23. (d): The electrode at which electrons are lost is called anode.

24. (a): In $[MnO_4]^-$, oxidation state of $_{25}Mn$ is +7.

Valence shell electronic configuration of $_{25}Mn$ is $3d^5\ 4s^2$ and Mn^{+7} is $3d^0 4s^0$.

25. (a): $\underset{\text{Benzyl phenyl ether}}{C_6H_5CH_2OC_6H_5} + HI \longrightarrow C_6H_5OH + C_6H_5CH_2I$

26. (d): Catalyst increases rate of reaction, without altering equilibrium.

27. (b): Ag_2SO_4 contains $Ag^+(4d^{10})$ which is colourless due to completely filled *d*-subshell.

CuF_2 contains $Cu^{2+}(3d^9)$ ion which is coloured due to partially filled *d*-subshell.

MgF_2 contains Mg^{2+} ion which is colourless due to lack of *d*-electrons.

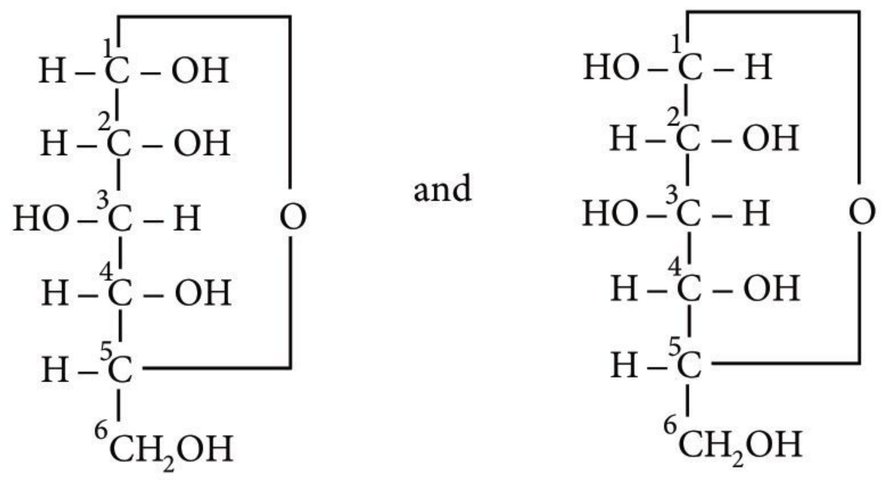
CuCl contains $Cu^+(3d^{10})$ which is colourless due to completely filled *d*-subshell So, the is no *d*–*d* transition possible.

28. (a)

29. (d): Point defects are present in ionic solids.

30. (a)

31. (b): A pair of stereoisomer which differ in configuration only around C_1 are called anomers.



α-*D*(+)-glucopyranose β-*D*(+)-glucopyranose

Two forms of *D*-glucopyranose are, α-*D*(+)-glucopyranose and β-*D*(+)-glucopyranose. These are called anomers.

32. (d)

33. (d): Teflon is used to make non-stick cookware.

34. (b): $CCl_3CHO + 2\ C_6H_5Cl \xrightarrow{\text{Conc. } H_2SO_4} CCl_3CH(C_6H_4Cl)_2$

p,*p*′-dichlorodiphenyltrichloroethane (DDT)

35. (b) **36. (b)**

37. (d): F—F bond in F_2 is weak due to repulsion between lone pairs of small F atom.

38. (b)

39. (a): A - p,q,s ; B - p,r,s ; C - q,s ; D - q,s

In all the complexes, the oxidation state of central metal ion is +2. Any complex with molecular formula MA_2B_2 shows geometrical isomerism. Moreover, valence shell electron configuration of Co^{2+} in $[Co(NH_3)_4(H_2O)_2]Cl_2$, $[Co(H_2O)_5Cl]Cl$ and Ni^{2+} in $[Ni(H_2O)_6]Cl_2$ (all are attached to weak field ligands) suggest that there are unpaired electrons (paramagnetic) whereas Pt^{2+} do not have any unpaired electrons, hence, it is diamagnetic.

40. (b) **41. (a)**

42. (a): $-I$ effect of the substituent follows the order F > Cl > Br.

Hence, order of relative acidic strength is $FCH_2COOH > ClCH_2COOH > BrCH_2COOH$.

43. (c): As the distance from electronegative group increases, acidity of —COOH group decreases.

44. (a)

45. (d): pH in the small intestine is about 8 and therefore, it is basic in nature and aspirin is completely ionized here, since the pH in the stomach is 2.3 and therefore, it is highly acidic medium, aspirin being weakly acidic will be almost completely unionized here.

46. (a): $W = ZIt$

47. (b): $Q = It$ or $Q = 10 \times 10^{-3} \times t$ ....(i)

$$\therefore \quad t = \frac{Q}{10 \times 10^{-3}} \text{ sec}$$

$2H_2O + 2e^- \longrightarrow H_2 + 2OH^-$

0.01 mole of H_2 is liberated by 0.02 Faraday of charge.

i.e., $Q = 0.02 \times 96500$ ....(ii)

from (i) and (ii), $10 \times 10^{-3} \times t = 0.02 \times 96500$

$$\therefore \quad t = \frac{0.02 \times 96500}{10 \times 10^{-3}} = 19.3 \times 10^4 \text{ sec}$$

48. (d): During electrolysis of $CuSO_4$, Cu^{2+} gets discharged at cathode and OH^- at anode. Thus, solution becomes acidic due to excess of H^+ ions and SO_4^{2-} ions or H_2SO_4.

49. (c): One Faraday deposits one gram equivalent of copper on cathode.

50. (a)

WB JEE

SOLVED PAPER 2022

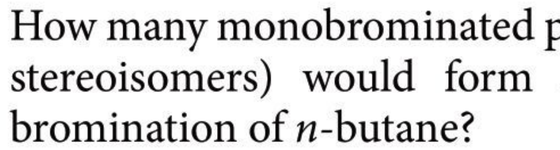
CATEGORY-I (Q. 1 to Q. 30)

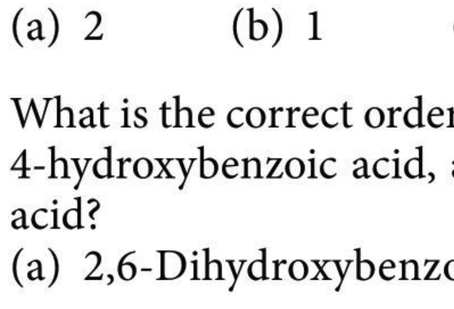
Carry-1 mark each. Only one option is correct. Negative marks –1/4.

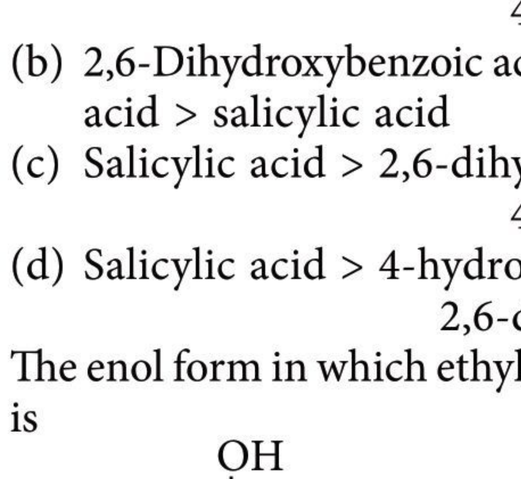
1. How many monobrominated product(s) (including stereoisomers) would form in the free radical bromination of *n*-butane?
(a) 2 (b) 1 (c) 3 (d) 4

2. What is the correct order of acidity of salicylic acid, 4-hydroxybenzoic acid, and 2-6-dihydroxybenzoic acid?
(a) 2,6-Dihydroxybenzoic acid > salicylic acid > 4-hydroxybenzoic acid
(b) 2,6-Dihydroxybenzoic acid > 4-hydroxybenzoic acid > salicylic acid
(c) Salicylic acid > 2,6-dihydroxybenzoic acid > 4-hydroxybenzoic acid
(d) Salicylic acid > 4-hydroxybenzoic acid > 2,6-dihydroxybenzoic acid

3. The enol form in which ethyl-3-oxobutanoate exists is

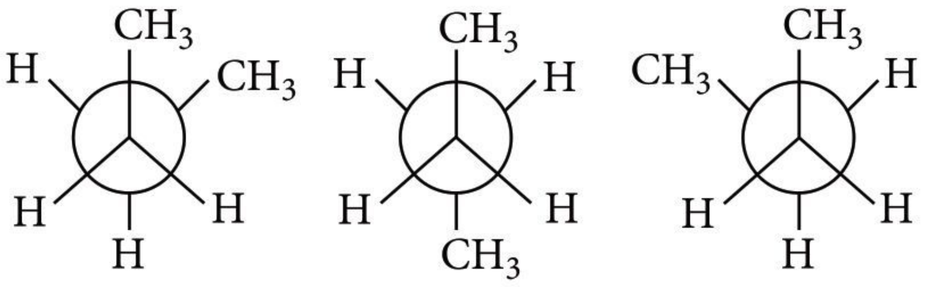
(a) 

(b) 

(c) 

(d)

4. The correct order of relative stability of the given conformers of *n*-butane is



I II III

(a) II > I = III (b) II > III > I
(c) II > I > III (d) I = III > II

5. $C_6H_{6(l)} + \frac{15}{2} O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(l)}$

Benzene burns in oxygen according to the above equation. What is the volume of oxygen (at STP) needed for complete combustion of 39 gram of liquid benzene?
(a) 11.2 litre (b) 22.4 litre
(c) 84 litre (d) 168 litre

6. How much solid oxalic acid (molecular weight 126) has to be weighed to prepare 100 mL exactly 0.1 (N) oxalic acid solution in water?
(a) 1.26 g (b) 0.126 g
(c) 0.63 g (d) 0.063 g

7. The major product of the following reaction is

$F_3C-CH=CH_2 + HBr \longrightarrow$

(a) $F_3C-CH_2-CH_2Br$
(b) $F_3C-CH(Br)-CH_3$
(c) $F_2C(Br)-CH(F)-CH_3$
(d) $F_2CH-CH(Br)-CH_2F$

8. In Bohr model of atom, radius of hydrogen atom in ground state is r_1 and radius of He^+ ion in ground state is r_2. Which of the following is correct?
(a) $\frac{r_1}{r_2} = 4$ (b) $\frac{r_1}{r_2} = \frac{1}{2}$
(c) $\frac{r_2}{r_1} = \frac{1}{4}$ (d) $\frac{r_2}{r_1} = \frac{1}{2}$

9. Which one of the following is the correct set of four quantum numbers (n, l, m, s)?

(a) $\left(3, 0, -1, +\frac{1}{2}\right)$ (b) $\left(4, 3, -2, -\frac{1}{2}\right)$

(c) $\left(3, 1, -2, -\frac{1}{2}\right)$ (d) $\left(4, 2, -3, +\frac{1}{2}\right)$

10. Avogadro's law is valid for

(a) all gases (b) ideal gas

(c) van der Waals' gas (d) real gas.

11. A metal (M) forms two oxides. The ratio M : O (by weight) in the two oxides are 25:4 and 25:6. The minimum value of atomic mass of M is

(a) 50 (b) 100 (c) 150 (d) 200

12. The de-Broglie wavelength (λ) for electron (e), proton (p) and He^{2+} ion (α) are in the following order. Speed of e, p and α are the same.

(a) $\alpha > p > e$ (b) $e > p > \alpha$

(c) $e > \alpha > p$ (d) $\alpha < p > e$

13. 1 mL of water has 25 drops. Let N_0 be the Avogadro number. What is the number of molecules present in 1 drop of water? (Density of water = 1 g/mL)

(a) $\frac{0.02}{9}N_0$ (b) $\frac{18}{25}N_0$

(c) $\frac{25}{18}N_0$ (d) $\frac{0.04}{25}N_0$

14. The number of unpaired electron in Mn^{2+} ion is

(a) 2 (b) 3 (c) 5 (d) 6

15. The average speed of H_2 at T_1 K is equal to that of O_2 at T_2 K. The ratio $T_1 : T_2$ is

(a) 1 : 6 (b) 16 : 1

(c) 1 : 4 (d) 1 : 1

16. A sample of $MgCO_3$ is dissolved in dil. HCl and the solution is neutralized with ammonia and buffered with NH_4Cl/NH_4OH. Disodium hydrogen phosphate reagent is added to the resulting solution. A white precipitate is formed. What is the formula of the precipitate?

(a) $Mg_3(PO_4)_2$ (b) $Mg(NH_4)PO_4$

(c) $MgHPO_4$ (d) $Mg_2P_2O_7$

17. XeF_2, NO_2, HCN, ClO_2, CO_2.
Identify the non-linear molecule-pair from the above mentioned molecules.

(a) XeF_2, ClO_2 (b) CO_2, NO_2

(c) HCN, NO_2 (d) ClO_2, NO_2

18. The number of atoms in body centred and face centred cubic unit cell respectively are

(a) 2 and 4 (b) 4 and 3

(c) 1 and 2 (d) 4 and 6

19. The metal-pair that can produce nascent hydrogen in alkaline medium is

(a) Zn, Al (b) Fe, Ni

(c) Al, Mg (d) Mg, Zn

20. The correct bond order of B-F bond in BF_3 molecule is

(a) 1 (b) $1\frac{1}{2}$ (c) 2 (d) $1\frac{1}{3}$

21. Sodium nitroprusside is

(a) $Na_4[Fe(CN)_5NO_2]$ (b) $Na_2[Fe(CN)_5NO]$

(c) $Na_3[Fe(CN)_5NO]$ (d) $Na_4[Fe(CN)_5NO_3]$

22. Choose the correct statement for the $[Ni(CN)_4]^{2-}$ complex ion (Atomic no. of Ni = 28).

(a) The complex is square planar and paramagnetic.

(b) The complex is tetrahedral and diamagnetic.

(c) The complex is square planar and diamagnetic.

(d) The complex is tetrahedral and paramagnetic.

23. The boiling point of the water is higher than liquid HF. The reason is that

(a) hydrogen bonds are stronger in water

(b) hydrogen bonds are stronger in HF

(c) hydrogen bonds are larger in number in HF

(d) hydrogen bonds are larger in number in water.

24. To a solution of colourless sodium salt, a solution of lead nitrate was added to have a white precipitate which dissolves in warm water and reprecipitates on cooling. Which of the following acid radical is present in the salt?

(a) Cl^- (b) SO_4^{2-} (c) S^{2-} (d) NO_3^-

25. Oxidation states of Cr in $K_2Cr_2O_7$ and CrO_5 are, respectively

(a) +6, +5 (b) +6, +10

(c) +6, +6 (d) none of these.

26. Which of the following is radioactive?

(a) Hydrogen (b) Deuterium

(c) Tritium (d) None of these

27. The correct order of acidity of the following hydra acids is

(a) HF > HCl > HBr > HI

(b) HF < HCl < HBr < HI

(c) HF < HCl > HBr > HI

(d) HF > HCl < HBr > HI

28. $\bar{\underset{\cdot\cdot}{C}}H_3$ (i) $H_2\bar{\underset{\cdot\cdot}{C}}-CHOCH_3$ (ii)

Hybridisation of the negative carbons in (i) and (ii) are

(a) sp^2 and sp^3 (b) sp^3 and sp^2

(c) both sp^2 (d) both sp^3.

18+

WHAT IS AVAXHOME?

AVAXHOME-

the biggest Internet portal, providing you various content: brand new books, trending movies, fresh magazines, hot games, recent software, latest music releases.

Unlimited satisfaction one low price
Cheap constant access to piping hot media
Protect your downloadings from Big brother
Safer, than torrent-trackers

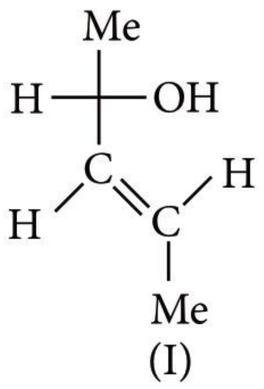
18 years of seamless operation and our users' satisfaction

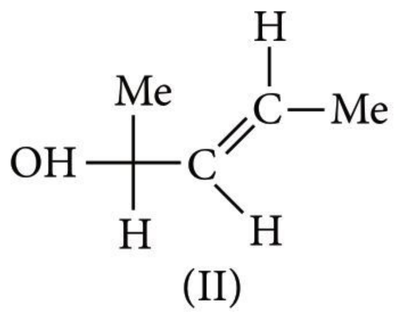
All languages
Brand new content
One site

AVXLIVE.ICU

AvaxHome - Your End Place

We have everything for all of your needs. Just open https://avxlive.icu

29. 
(I)

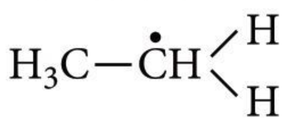

(II)

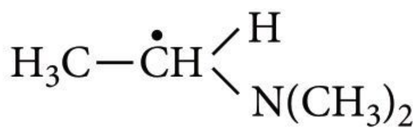
The correct relationship between molecules I and II is

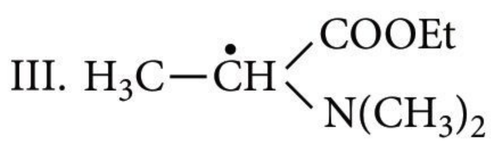
(a) enantiomer (b) homomer

(c) diastereomer (d) constitutional isomer.

30. The correct order of relative stability for the given free radicals is

I. 

II. 

III. 

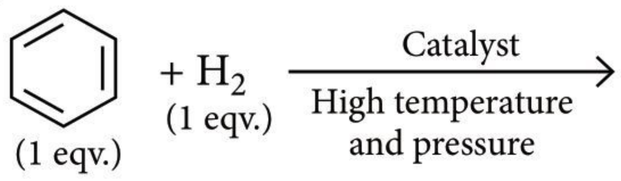
(a) II > I > III (b) II > III > I

(c) III > I > II (d) III > II > I

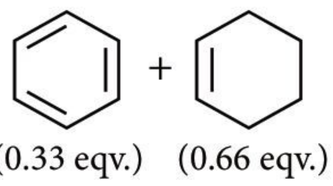
CATEGORY-II (Q. 31 to Q. 35)

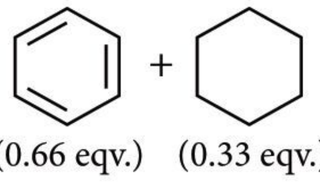
Carry-2 marks each. Only one option is correct. Negative marks : 1/2.

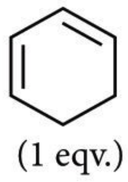
31. The product of the following hydrogenation reaction is



(a) 
(1 eqv.)

(b) 
(0.33 eqv.) (0.66 eqv.)

(c) 
(0.66 eqv.) (0.33 eqv.)

(d) 
(1 eqv.)

32. Pick the correct statement.

(a) Relative lowering of vapour pressure is independent of *T*.

(b) Osmotic pressure always depends on the nature of solute.

(c) Elevation of boiling point is independent of nature of the solvent.

(d) Lowering of freezing point is proportional to the molar concentration of solute.

33. Let $(C_{rms})_{H_2}$ is the *r.m.s* speed of H_2 at 150 K. At what temperature, the most probable speed of helium $[(C_{mp})_{He}]$ will be half of $(C_{rms})_{H_2}$?

(a) 75 K (b) 112.5 K

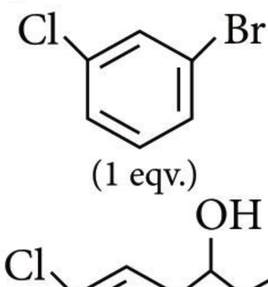
(c) 225 K (d) 900 K

34. The correct pair of electron affinity order is

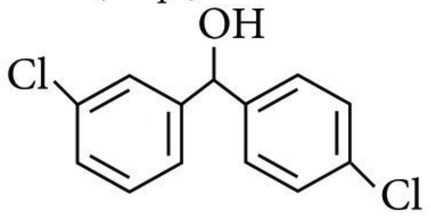
(a) O > S, F > Cl (b) O < S, Cl > F

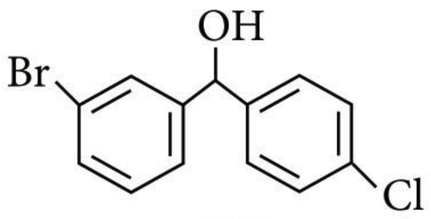
(c) S > O, F > Cl (d) S < O, Cl > F

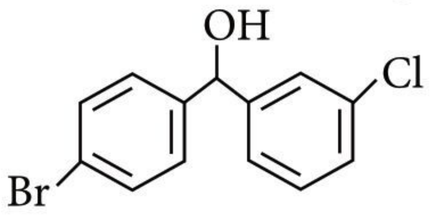
35. The product of the following reaction is

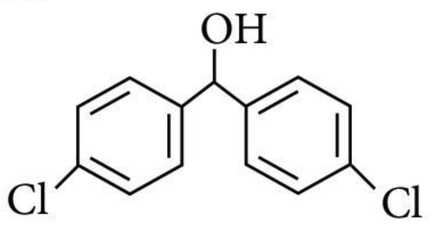

(1 eqv.)

1. Mg, Et_2O(dry)
2. 4-Chlorobenzaldehyde
3. aq. NH_4Cl

(a) 

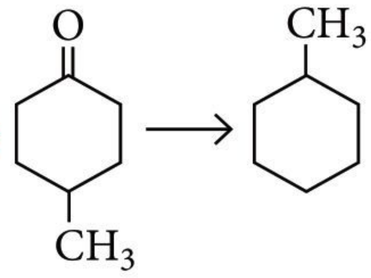
(b) 

(c) 

(d) 

CATEGORY-III (Q. 36 to Q. 40)

Carry-2 marks each. One or more options are correct. No negative marks.

36. 

The above conversion can be carried out by,

(a) Zn – Hg/Conc. HCl

(b) (i) H_2NNH_2, (ii) NaOH in ethylene glycol, Δ

(c) (i) $HSCH_2CH_2SH/H^+$, (ii) H_2/Ni

(d) bromine water.

37. Which of the statements are incorrect?

(a) pH of a solution of salt of strong acid and weak base is less than 7

(b) pH of a solution of a weak acid and weak base is basic if $K_b < K_a$.

(c) pH of an aqueous solution of 10^{-8} (M) HCl is 8

(d) Conjugate acid of NH_2^- is NH_3.

38. During the preparation of NH_3 in Haber's process, the promoter(s) used is (are)

CONCEPT MAP

THE SOLID STATE

Classification Based on Crystal Lattice

Crystalline Solids

- True solids
- Anisotropic
- Have definite pattern of arrangements of atoms, ions or molecules
- Exhibit plane, axis and centre of symmetry
- Long range order
- Are categorised according to intermolecular forces into : Molecular, ionic, metallic and covalent solids.

Amorphous Solids

- Isotropic
- Pseudo solids or supercooled liquids
- Do not have a definite pattern of arrangement
- Short range order
- Do not show any symmetry

Classification Based on Magnetic Properties

- **Diamagnetic substances :** Substances which are weakly repelled by external magnetic field, *e.g.*, N_2, NaCl, Zn, TiO_2, etc.
- **Paramagnetic substances :** Substances which are weakly attracted by external magnetic field, *e.g.*, O_2, Cu^{2+}, Fe^{3+}, Cr^{3+}, etc.
- **Ferromagnetic substances :** Substances which show permanent magnetism even in the absence of external magnetic field, *e.g.*, Ni, Fe, Co, etc.
- **Antiferromagnetic substances :** Substances which have zero net dipole moment even though they have large number of unpaired electrons, *e.g.*, MnO.
- **Ferrimagnetic substances :** These are the substances which possess very small net magnetic moment even though they have large number of unpaired electrons, *e.g.*, Fe_3O_4.

Crystal Lattice and Unit Cells

Primitive Unit Cells

- Constituent particles are present only at the corners of the unit cell.
- Consist of 7 types of arrangements with cubic as most symmetric and triclinic as least symmetric.

Centred Unit Cells

Constituent particles are present at the corners and at :

- the centre of the unit cell (*bcc*)
- the centre of each face of the unit cell (*fcc*)
- the centre of any two opposite faces (End-centred)

Cubic System

$$\rho = \frac{Z \times M}{a^3 \times N_A}\ g\ cm^{-3}$$

Type	Simple cubic	*bcc*	*fcc*
Z	$8 \times \frac{1}{8} = 1$	$8 \times \frac{1}{8} + 1 \times 1 = 2$	$8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$
C. No.	6	8	12
Relation of *r*, *d* & *a*	$r = \frac{d}{2} = \frac{a}{2}$ since $d = a$	$r = \frac{d}{2} = \frac{\sqrt{3}a}{4}$ since $d = \frac{\sqrt{3}a}{2}$	$r = \frac{d}{2} = \frac{a}{2\sqrt{2}}$ since $d = \frac{a}{\sqrt{2}}$
Packing Efficiency	52.4%	68%	74%

Types of Defects

Non-stoichiometric Defect

Arises due to the presence of constituent particles in non-stoichiometric ratio.

Stoichiometric Defect (Intrinsic or Thermodynamic Defect)

Does not disturb the stoichiometry of solid.

Frenkel Defect

- It is due to dislocation of smaller ions (usually cation) from its lattice site to an interstitial sites.
- Does not effect the density of crystal.
- This is found in ionic compounds having large difference in size of ions. *E.g.*, AgI, ZnS, etc.

Schottky Defect

- It is due to equal no. of missing cations and anions from lattice sites.
- It results in decrease in density of crystal.
- This is found in ionic compounds having cation and anion of almost same size, *e.g.*, NaCl, CsCl, etc.

Voids

Type	Size	No. of Voids
Octahedral	0.414 *R*	*N*
Tetrahedral	0.225 *R*	2*N*

Metal excess defect : Arises due to anionic vacancies, leaving a hole which is occupied by an electron thus, maintaining electrical balance. The anionic sites, occupied by unpaired electrons, are called *F*-centres and these impart colour to crystals.

Metal deficiency defect : Arises when metal shows variable valency *i.e.*, in transition metals. The defect occurs due to missing of a cation from its lattice site and the presence of the cation having higher charge in the adjacent lattice site.

CONCEPT MAP

SOLUTIONS

Expressing Concentration of Solutions

- Strength of solution $= \frac{\text{Mass of solute in g}}{\text{Volume of solution in L}}$
- Molarity, $M = \frac{w_B}{M_B \times V_{(mL)}} \times 1000$
- Molality, $m = \frac{w_B \times 1000}{M_B \times w_A (\text{in g})}$
- Normality $= \frac{w_B}{M_{(\text{equilvalent})} \times V_{(\text{in mL})}} \times 1000$
- Normality $= \frac{\text{Molarity} \times \text{Molar mass}}{\text{Equivalent mass}}$
- Normality of an acid = molarity × basicity
- Normality of a base = molarity × acidity
- $\text{ppm} = \frac{w_B}{w_A + w_B} \times 10^6$
- Mole fraction of component *A*, $x_A = \frac{n_A}{n_A + n_B}$
- Mole fraction of component *B*, $x_B = \frac{n_B}{n_A + n_B}$
- $x_A + x_B = 1$

- **Henry's law :** $p = K_H \cdot x$, Different gases have different K_H values at the same temperature. This suggests that K_H is a function of the nature of the gas.
- **Raoult's law :** $p_1 = p_1^\circ x_1$, this law is applicable only if the two components form a homogeneous mixture.
- **Dalton's law of partial pressure :** $p_{\text{total}} = p_1 + p_2 + \ldots p_n$ and for two components system, $p_{\text{total}} = p_1^\circ + (p_2^\circ - p_1^\circ)x_2$

Ideal Solutions	Non-ideal Solutions
Obey Raoult's law at all temperatures and concentrations.	Do not obey Raoult's law at all temperatures and concentrations.
$p_1 = x_1 p_1^\circ ; p_2 = x_2 p_2^\circ$	$p_1 \neq x_1 p_1^\circ ; p_2 \neq x_2 p_2^\circ$
$\Delta H_{mix} = 0, \Delta V_{mix} = 0$	$\Delta H_{mix} \neq 0, \Delta V_{mix} \neq 0$
A – *B* interactions ≈ *A* – *A* and *B* – *B* interactions	*A* – *B* interactions ≠ *A* – *A* and *B* – *B* interactions.
Do not form azeotropes (constant boiling mixtures)	Form azeotropes

Types of Solutions

Type of Solutions	Solute	Solvent	Examples
Gaseous Solutions	Gas	Gas	Mixture of oxygen and nitrogen gases
	Liquid	Gas	Chloroform mixed with nitrogen gas
	Solid	Gas	Camphor in nitrogen gas
Liquid Solutions	Gas	Liquid	Oxygen dissolved in water
	Liquid	Liquid	Ethanol dissolved in water
	Solid	Liquid	Glucose dissolved in water
Solid Solutions	Gas	Solid	Solution of hydrogen in palladium
	Liquid	Solid	Amalgam of mercury with sodium
	Solid	Solid	Copper dissolved in gold

Non-ideal Solutions Showing Positive and Negative Deviations from Raoult's Law

Solutions showing positive deviation	Solutions showing negative deviation
A – *B* << *A* – *A* or *B* – *B* interactions.	*A* – *B* >> *A* – *A* or *B* – *B* interactions.
$\Delta H_{mix} > 0, \Delta V_{mix} > 0$	$\Delta H_{mix} < 0, \Delta V_{mix} < 0$
$p_1 > p_1^\circ x_1$	$p_1 < p_1^\circ x_1$

Colligative Properties

- **Relative lowering of vapour pressure :** $(p_A^\circ - p_A) / p_A^\circ = x_B$
- **Elevation in boiling point :** $\Delta T_b = T_b - T_b^\circ = K_b m$
- **Depression in freezing point :** $\Delta T_f = T_f^\circ - T_f = K_f m$
- **Osmotic pressure :** $\pi = CRT = (n/V)RT$

van't Hoff Factor and its Significance

$$i = \frac{\text{Observed value of colligative property}}{\text{Calculated value of colligative property}}$$

- **For association of solute :** $nA \rightarrow (A)_n$
  Degree of association $(\alpha) = (1 - i)n/n - 1; i < 1$
- **For dissociation of solute :** $(A)_n \rightarrow nA$
  Degree of dissociation $(\alpha) = (i - 1)/n - 1; i > 1$
- **Modified colligative properties :**
  $(p_A^\circ - p_A)/p_A^\circ = ix_B ; \Delta T_b = iK_b m ; \Delta T_f = iK_f m ; \pi = iCRT$

(a) PtO_2 (b) Mo
(c) Mix of Al_2O_3 and K_2O
(d) Fe and Mn

39. The correct statement(s) about B_2H_6 is (are)
(a) all B atoms are sp^3 hybridised
(b) it is paramagnetic
(c) it contains 3*C*-4*e* bonding
(d) there are two types of H present.

40. Which of the following would produce enantiomeric products when reacted with methyl magnesium iodide?
(a) Benzaldehyde (b) Propiophenone
(c) Acetone (d) Acetaldehyde

SOLUTIONS

1. (c) : Free radical bromination of *n*-butane gives three monobrominated products including stereoisomers. Complete reaction is shown as:

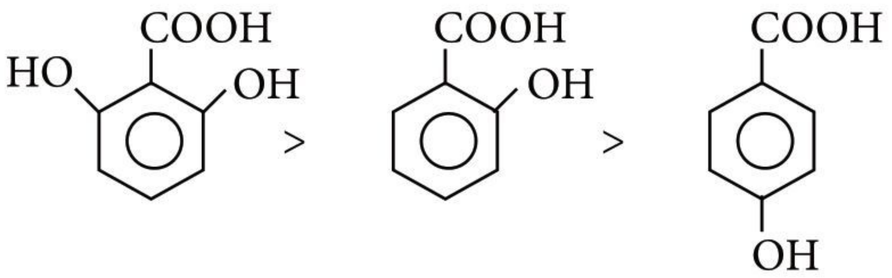
$$\underset{\text{n-Butane}}{CH_3CH_2CH_2CH_3} \xrightarrow{Br_2/UV\ light} \underset{\text{1-Bromobutane}}{CH_3CH_2CH_2CH_2Br}$$

$$+\ CH_3-\underset{\underset{Br}{|}}{\overset{\overset{H}{|}}{C^{*}}}-CH_2-CH_3$$

2-Bromobutane

There is one chiral carbon atom present in 2-bromobutane. Therefore, total number of stereoisomers = $2^n = 2^1 = 2$
Thus, total number of monobrominated products will be 1 + 2 = 3.

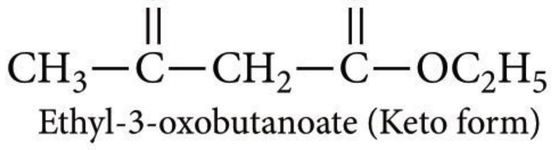
2. (a) : The correct order of acidity is as follows:



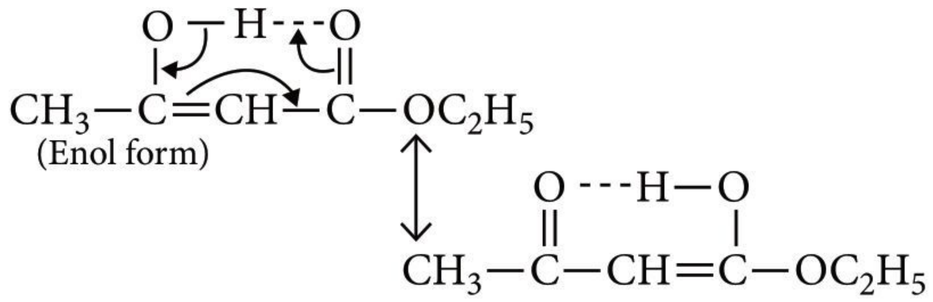
(i) 2,6-Dihydroxybenzoic acid > (ii) Salicylic acid > (iii) 4-Hydroxybenzoic acid

Acidity of benzoic acid increases by the presence of electron withdrawing group and decreases by the presence of electron donating group. The *ortho* substituted benzoic acids are stronger acids than benzoic acid despite the nature of substituent. This is referred to as *ortho*-effect.
(i) is most acidic due to presence of two —OH groups at both *ortho* positions.
(ii) is less acidic than (i) but more acidic than (iii) due to presence of an —OH group at one of the *ortho* positions.
(iii) is least acidic as the —OH group is present at *para* position.

3. (c) : The enol form in which ethyl-3-oxobutanoate exists is option (c).

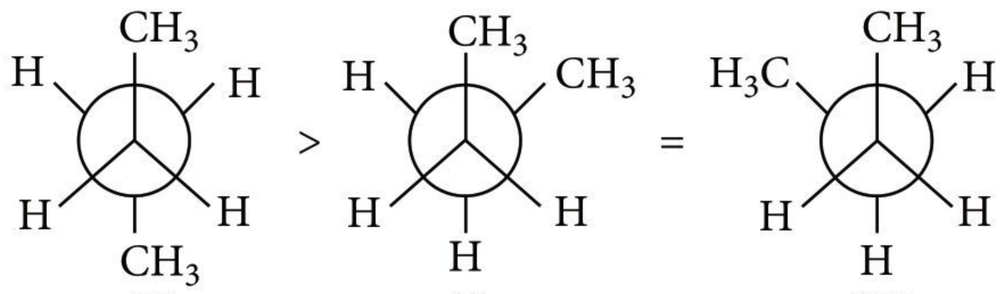


Ethyl-3-oxobutanoate (Keto form)



(Enol form)

4. (a) :



(II) Anti > (I) Gauche = (III) Gauche

Anti conformation is most stable in which methyl groups are far apart. This causes minimum repulsion. In conformations (I) and (III), the methyl groups are so close that they repel each other, hence stability is less. Thus, the correct order of relative stability of the given conformers of *n*-butane is II > I = III

5. (c) : $\underset{78\ g}{C_6H_{6(l)}} + \frac{15}{2}O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(l)}$

For 1 mole of C_6H_6 = $\frac{15}{2}$ moles of O_2 is required.

For $\frac{39}{78}$ or 0.5 mole of C_6H_6 = $\frac{15}{4}$ moles of O_2 will be required.

$\therefore$ Oxygen required at STP = $\frac{15}{4} \times 22.4 = 84$ L

6. (c) : $\text{Normality} = \frac{w \times 1000}{E \times V}$

$$0.1 = \frac{w}{126/2} \times \frac{1000}{100} \Rightarrow 0.1 = \frac{w}{63} \times 10 \Rightarrow \frac{0.1 \times 63}{10} = w$$

$w = 0.63$ g

7. (a) : The major product of the given reaction is $F_3C-CH_2CH_2Br$.

Complete reaction is as follows :

$F_3C-CH=CH_2 + HBr \longrightarrow F_3C-CH_2CH_2Br$

The presence of strong electron withdrawing group leads to a formation of a less stable carbocation on the middle carbon atom. The major product is formed with respect to the stable carbocation on terminal carbon atom attached to double bond.

8. (d) : Radius for the n^{th} Bohr orbit $= \frac{n^2 a_0}{Z}$

where, $a_0 = 0.53$ Å

For hydrogen atom, $r_1 = \frac{1^2 \times 0.53}{1} = 0.53$ ...(i)

For He^+ ion, $r_2 = \frac{1^2 \times 0.53}{2} = \frac{0.53}{2}$ ...(ii)

From (i) and (ii)

$\therefore \quad \frac{r_1}{r_2} = \frac{2}{1} \Rightarrow \frac{r_2}{r_1} = \frac{1}{2}$

9. (b) : For $n = 4$

$l = 0$ to $(n - 1)$ *i.e.*, 0 to 3

For $l = 3$, $m = 3, 2, 1, 0, -1, -2, -3$

So, only option (b) is correct.

10. (b) : Ideal gases follow Avogadro's law.

11. (b) : Let first oxide be M_2O_x and second oxide be M_2O_y

For M_2O_x, $\frac{2A}{16x} = \frac{25}{4}$ ...(i)

For M_2O_y, $\frac{2A}{16y} = \frac{25}{6}$ ...(ii)

(A = Atomic mass of M)

From (i) and (ii), values of x and y are obtained as,

$y = 3$, $x = 2$

We get, $\frac{2A}{16 \times 2} = \frac{25}{4}$

$A = 100$

12. (b) : According to de Broglie wavelength,

$\lambda = \frac{h}{mv}$; (Given : the speed is same, so $\lambda \propto \frac{1}{m}$)

Mass of $\alpha = 4 \times$ mass of p

Mass of $p = 1836 \times$ mass of e^-

Decreasing order of de-Broglie wavelength : $e^- > p > \alpha$

13. (a) : 1 mL of H_2O = 25 drops

Volume of 25 drops = 1 mL

Volume of 1 drop = $\frac{1}{25}$ mL

Density of H_2O = 1g/mL

Mass of 1 drop of $H_2O = 1 \times \frac{1}{25} = \frac{1}{25}$ g

18 g of H_2O contains 6.022×10^{23} or N_0 molecules

$\frac{1}{25}$ g of H_2O will contain $\frac{N_0}{18} \times \frac{1}{25} = \frac{0.02}{9} N_0$ molecules

14. (c) : Mn^{2+} ions has d^5 electronic configuration.

[Ar] | 1 | 1 | 1 | 1 | 1 | | $3d^5$ | $4s^0$

So, it contains 5 unpaired electrons.

15. (None) : $v_{average} = \sqrt{\frac{8RT}{\pi M}}$

$v_{O_2} = \sqrt{\frac{8RT_2}{32\pi}} \quad v_{H_2} = \sqrt{\frac{8RT_1}{2\pi}}$

$v_{O_2} = v_{H_2}$

$\sqrt{\frac{8RT_2}{32\pi}} = \sqrt{\frac{8RT_1}{2\pi}}$; $\frac{T_2}{32} = \frac{T_1}{2} \Rightarrow \frac{T_1}{T_2} = \frac{1}{16}$

Note : None of the given options is correct.

16. (b) : Reactions involved are as follows:

$MgCO_3 + HCl(dil.) \longrightarrow MgCl_2 + H_2CO_3$

$MgCl_2 + Na_2HPO_4 + NH_4OH \longrightarrow Mg(NH_4)PO_4 + 2NaCl + H_2O$

Thus, formula of precipitate is Mg $(NH_4)PO_4$.

17. (d) : XeF_2, HCN and CO_2 are linear molecules.

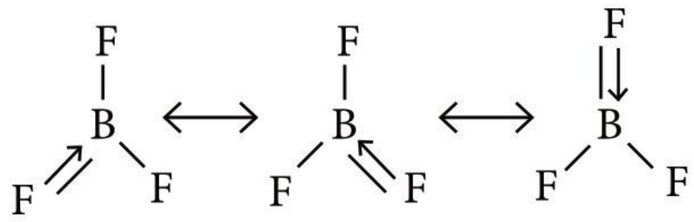
18. (a) : *bcc* contains 2 atoms per unit cell while *fcc* contains 4 atoms per unit cell.

19. (a) : Zn and Al metal-pair produces nascent hydrogen in alkaline medium.

$Zn + 2NaOH \longrightarrow Na_2ZnO_2 + 2[H]$

$2Al + 2NaOH \longrightarrow 2NaAlO_2 + 2[H]$

20. (d) : Resonating structures of BF_3:

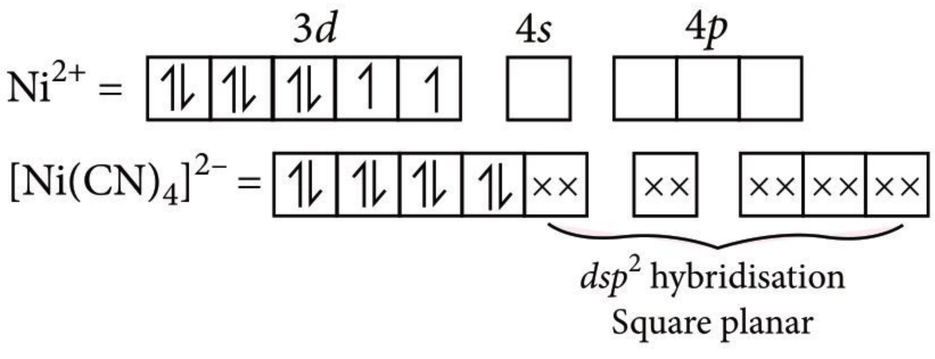


$$\text{Bond order} = \frac{\text{Number of bonds in any one resonating structure}}{\text{Total number of resonating structures due to back bonding}}$$

$$= \frac{4}{3} = 1\frac{1}{3}$$

21. (b) : Sodium nitroprusside is $Na_2[Fe(CN)_5NO]$.

22. (c) : In $[Ni(CN)_4]^{2-}$, nickel is present as Ni^{2+}.
So, its configuration = $3d^8 4s^0$



Thus, the complex is square planar and diamagnetic.

23. (d) : The boiling point of the water is higher than liquid HF. The reason is that hydrogen bonds are larger in number in H_2O. Due to extensive H-bonding in water, large amount of energy is required to break all bonds.

24. (a) : Cl^- is present in the salt that gives white precipitate with lead nitrate.

$$2NaCl + PbNO_3 \longrightarrow \underset{\text{(White ppt.)}}{PbCl_2} + 2NaNO_3$$

$PbCl_2$ is soluble in hot water and on cooling white crystals are again formed.

25. (c) : Oxidation states of Cr in $K_2Cr_2O_7$ and CrO_5 are +6 and +6 respectively.

$K_2Cr_2O_7$:

$2(+1) + 2(x) + 7(-2) = 0$; $2x = 12$, $x = +6$

CrO_5:

$$x + \underset{\text{(for Cr = O)}}{1 \times (-2)} + \underset{\text{(for Cr − O)}}{4(-1)} = 0$$

$x - 6 = 0 \Rightarrow x = +6$

26. (c) : Tritium (^3_1H) is the radioactive isotope of hydrogen. It is unstable.

27. (b) : The correct order of acidity the hydra-acids is HF < HCl < HBr < HI.
On moving down the group, the size of halogen atoms increases. As a result, the bond strength of H—X bond decreases. Thus, H^+ can be released easily which leads to increase in acidic strength.

28. (d) : Hybridisation of C in CH_3^-(i) and $\bar{C}H_2CHOCH_3$ (ii) is sp^3.

Note : The $—\bar{C}HOCH_3$ in (ii) could be either $—COCH_3$ or $—CH_2OCH_3$ because valency of carbon is not satisfied in given compound.

29. (b) : The configuration of optically active carbon in both (I) and (II) is '*S*'. So, the molecule I and II are homomer.

30. (d) : (III) is most stable due to resonance. (II) is more stable than (I) because of presence of electron donating $-\ddot{N}(CH_3)_2$ group. Hence, the correct order of stability is (III) > (II) > (I).

Note : The valency of C possessing the free radical is not satisfied.

31. (c)

32. (a) : Osmotic pressure depends on nature of solvent, concentration of solution and temperature.
Lowering of freezing point is proportional to the molality of solute.
Elevation of boiling point is dependent on nature of solvent.

33. (b) : $(C_{rms})_{H_2} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3R \times 150}{2}}$

Given, $(C_{mp})_{He} = \frac{1}{2}(C_{rms})_{H_2}$

$$(C_{mp})_{He} = \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2RT}{4}}$$

$$\Rightarrow \sqrt{\frac{2RT}{4}} = \frac{1}{2}\sqrt{\frac{3R \times 150}{2}}$$

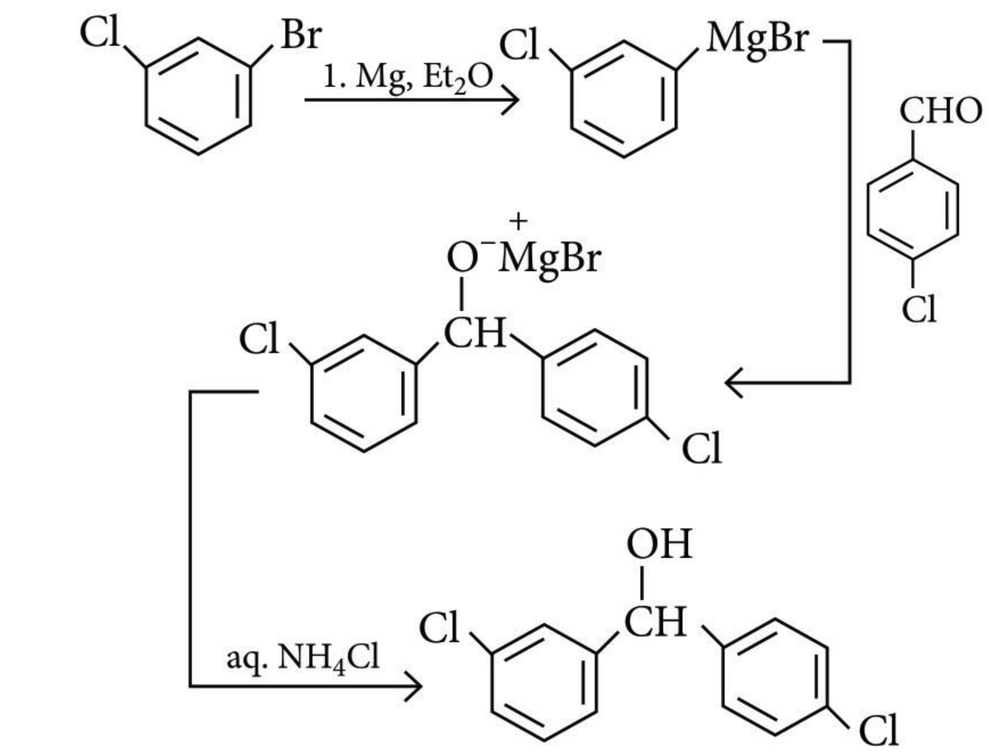
$$\frac{2RT}{4} = \frac{1}{4} \times \frac{3R \times 150}{2}$$

On solving $T = 112.5$ K

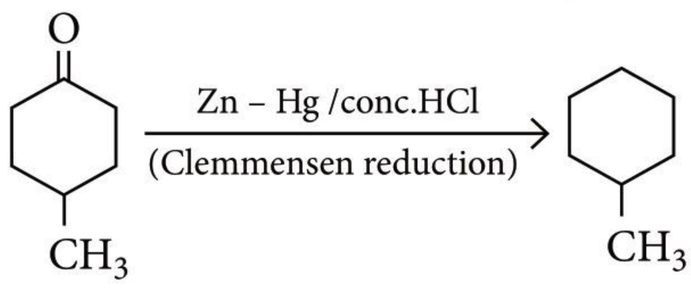
34. (b) : Electron affinity of S is more than O due to lesser $e^- - e^-$ repulsion in sulphur whereas Cl has more

electron affinity than F due to larger size and lesser electronic repulsion.

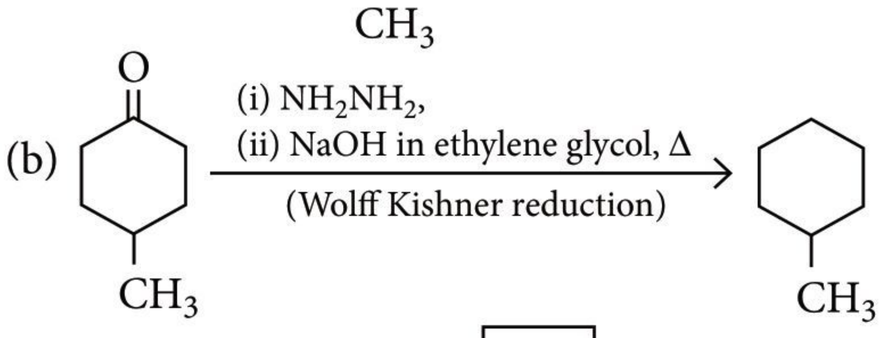
35. (a) :



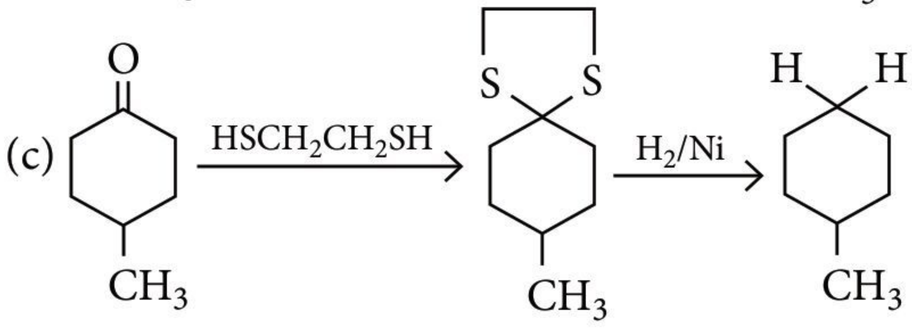
36. (a,b,c) : (a)



(b)



(c)



37. (b, c) : pH of a solution of salt of strong acid and weak base is less than 7

pH of solution of a weak acid and weak base depends on strength of acid or base.

$$pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$$

If $pK_a > pK_b$ or $K_b > K_a$, the solution is basic.

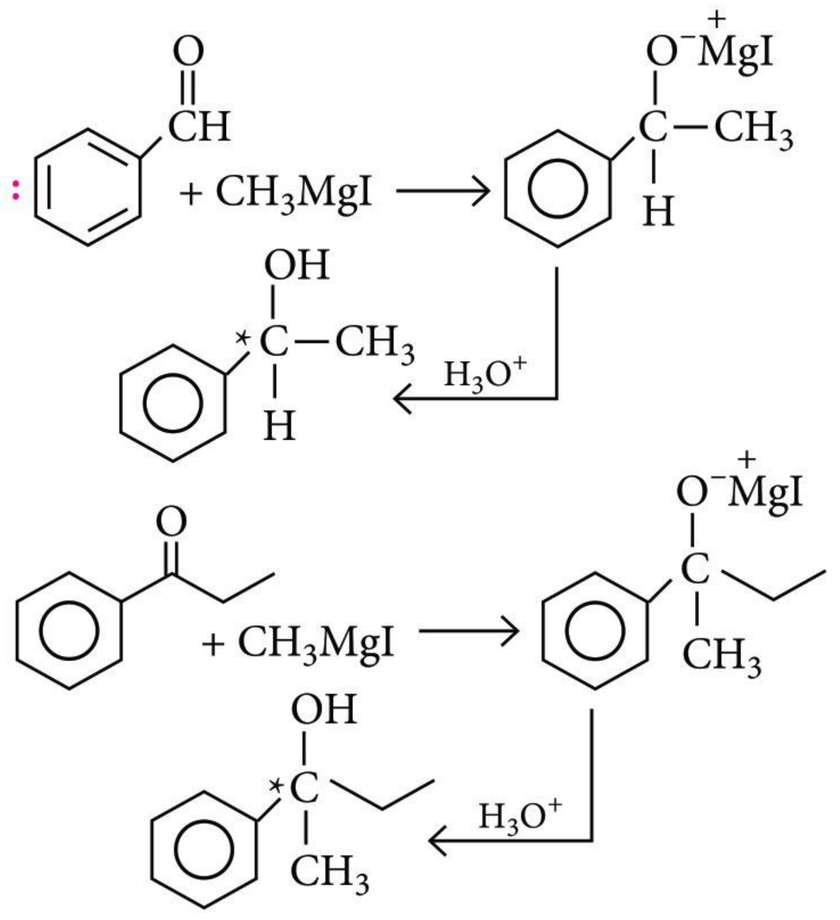
pH of an aqueous solution of 10^{-8} M HCl is less than 7.

Conjugate acid of NH_2^- is NH_3

38. (b, c) : $N_{2(g)} + 3H_{2(g)} \xrightarrow[Mo_{(s)} \text{ or } K_2O + Al_2O_3]{Fe_{(s)}} 2NH_{3(g)}$

39. (a,d) : B_2H_6 is diamagnetic in nature and it has two types of hydrogen atoms *i.e.*, terminal hydrogen and bridge hydrogen.

40. (a,b) :

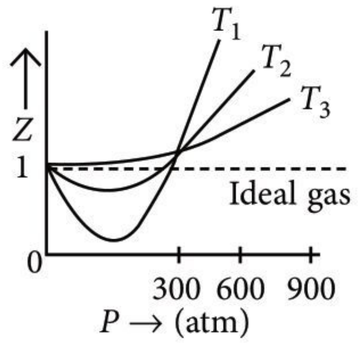


GET SET GO for NEET

with exclusive and brain storming MCQs

Practicing these MCQs help to strengthen your concepts and give you extra edge in your NEET preparation

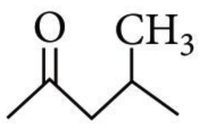
1. The variation of compressibility factor Z with pressure at different temperatures T_1, T_2 and T_3 is given as follows. Match the temperature in column I with the column II values.

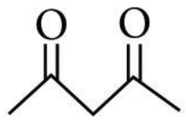


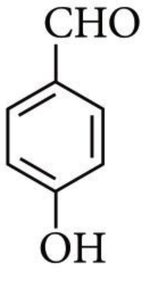
	Column I		Column II
A	T_1	1.	500 K
B	T_2	2.	1000 K
C	T_3	3.	200 K

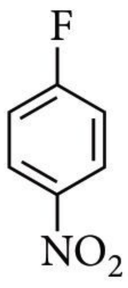
(a) A – 3, B – 1, C – 2 (b) A – 1, B - 2, C – 3
(c) A – 2, B – 3, C – 1 (d) A – 3, B - 2, C – 1

2. In which of the following species intramolecular H-bonding can be exhibited in the aqueous solution?

(a) 

(b) 

(c) 

(d) 

3. Which of the following statements about polar stratosphere clouds (PSCs) is not correct?

(a) PSCs do not react with chlorine nitrate and HCl.
(b) Type I clouds are formed at about –77°C and contain solid $HNO_3 \cdot 3H_2O$.
(c) Type II clouds are formed at about –85°C and contain some ice.
(d) A tight whirlpool of wind called Polar Vortex is formed which surrounds Antarctica.

4. During winters, moisture condenses in the form of dew and can be seen on plant leaves and grass. The entropy of the system in such cases decreases as liquids possess lesser disorder as compared to gases. With reference to the second law, which statement is correct, for the above process?

(a) The randomness of the universe decreases.
(b) The randomness of the surroundings decreases.
(c) Increase in randomness of surroundings equals to the decrease in randomness of system.
(d) The increase in randomness of the surroundings is greater as compared to the decrease in randomness of the system.

5. 3.92 g/L of a sample of ferrous ammonium sulphate reacts completely with 50 mL $\frac{N}{10}$ $KMnO_4$ solution. The percentage purity of the sample is

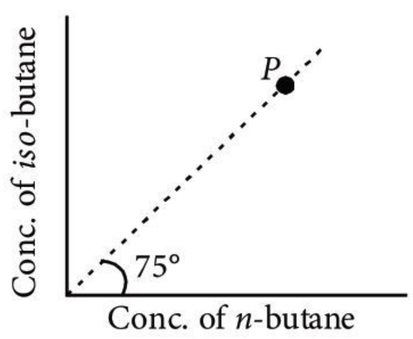
(a) 50 (b) 78.4

(c) 80.0 (d) 39.2

6. For the equilibrium

$$CH_3 - CH_2 - CH_2 - CH_3\ (g) \rightleftharpoons CH_3 - \underset{\displaystyle H}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - CH_3\ (g)$$

equilibrium constant is found to be 1.732 at 298 K. Now if in a vessel at 298 K, a mixture of these two gases be taken as represented by the point P in the figure, predict what will happen ?



(a) Immediately above equilibrium will be setup.

(b) Above reaction will go in the forward direction till it attains equilibrium.

(c) Above reaction will go in the backward direction till it attains equilibrium.

(d) Nothing can be said.

7. When a small amount of solid calcium phosphide, Ca_3P_2, is added to water, what are the most likely products?

(a) Aqueous Ca^{2+} and OH^- ions and PH_3 gas

(b) Aqueous Ca^{2+} and OH^- ions and aqueous H_3PO_3

(c) Solid CaH_2 and aqueous H_3PO_3

(d) Solid CaO and PH_3 gas

8. The electrons, identified by quantum number n and l (i) $n = 4, l = 1$ (ii) $n = 4, l = 0$ (iii) $n = 3, l = 2$ (iv) $n = 3, l = 1$ can be placed in order of increasing energy, from the lowest to highest, as

(a) (iv) < (ii) < (iii) < (i)

(b) (ii) < (iv) < (i) < (iii)

(c) (i) < (iii) < (ii) < (iv)

(d) (iii) < (i) < (iv) < (ii)

9. In halogens, with the increase of atomic number it is found that

(a) ionisation potential decreases

(b) ionic radii decreases

(c) tendency to lose electrons decreases

(d) in MX_2 (M = metal and X = halogen), covalent properties decreases.

10. Which one of the following reactions involves disproportionation?

(a) $2H_2SO_4 + Cu \rightarrow CuSO_4 + 2H_2O + SO_2$

(b) $As_2O_3 + 3H_2S \rightarrow As_2S_3 + 3H_2O$

(c) $2KOH + Cl_2 \rightarrow KCl + KOCl + H_2O$

(d) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

11. An organic compound A ($C_4H_{10}O$) has two enantiomeric forms and on dehydration it gives B (major product) and C (minor product). B and C are treated with HBr/peroxide and the compounds so produced were subjected to alkaline hydrolysis then

(a) B will give an isomer of A

(b) C will give an isomer of A

(c) neither of them will give isomer of A

(d) both B and C will give isomer of A.

12. Which pair of substances could be separated by mixing with water and filtering?

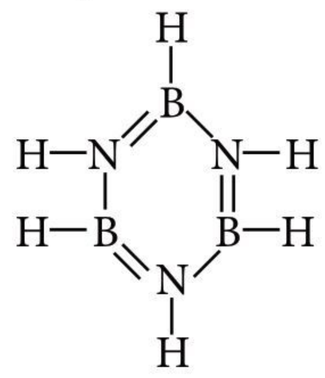
(a) $NaNO_3$ and K_2SO_4

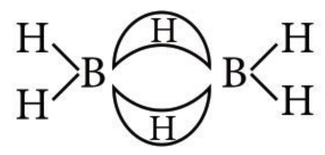
(b) CH_3OH and CH_3COCH_3

(c) $MgCO_3$ and $Fe(OH)_3$

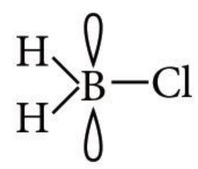
(d) KCl and CuS

13. Which of the following compounds is not matched correctly with its structure?

(a)  — Borazine

(b)  — Diborane

(c)  — Aluminium chloride

(d)  — Boron trichloride

14. 5 g of a fat reacts with 4.76 g of iodine. If the fat has molecular mass of 1600, the iodine number of the fat and number (gram of iodine which reacts with 100 g of fat)of double bonds per mole of fat respectively are

(a) 95 g and 4 (b) 93 g and 6

(c) 95 g and 6 (d) 93 g and 4.

15. In which of the following reactions, H_2O_2 acts as a reducing agent.

(a) $PbO_{2(s)} + H_2O_{2(aq)} \rightarrow PbO_{(s)} + H_2O_{(l)} + O_{2(g)}$

(b) $Na_2SO_{3(aq)} + H_2O_{2(aq)} \rightarrow Na_2SO_{4(aq)} + H_2O_{(l)}$

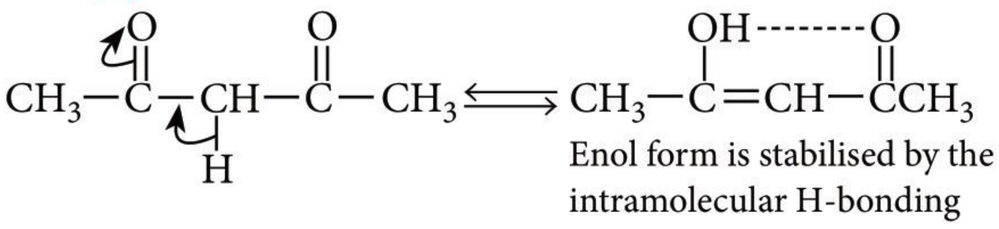
(c) $2KI_{(aq)} + H_2O_{2(aq)} \rightarrow 2KOH_{(aq)} + I_{2(s)}$

(d) $KNO_{2(aq)} + H_2O_{2(aq)} \rightarrow KNO_{3(aq)} + H_2O_{(l)}$

SOLUTIONS

1. (a) : At low pressure and high temperature a real gas tends towards ideal behaviour.

2. (b) :



Enol form is stabilised by the intramolecular H-bonding

3. (a) : PSCs react with chlorine nitrate and HCl to give HOCl and Cl_2.

4. (d) : As dew formation is spontaneous process, therefore, entropy or randomness of the universe will increase. As randomness of the system has decreased but randomness of the surrounding will increase significantly so that change is positive.

5. (a) : $N_1 \times V_1$ = $N_2 \times V_2$

$[FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O]$ $[KMnO_4]$

$$N_1 \times 1000 = \frac{1}{10} \times 50 \text{ or } N_1 = \frac{1}{200}$$

Eq. wt. of $FeSO_4 \cdot (NH_4)_2 SO_4 \cdot 6H_2O$ = Mol. wt. = 392 g mol^{-1}

$$\therefore \text{ Strength of pure salt } = 392 \times \frac{1}{200} = 1.96 \text{ g } L^{-1}$$

$$\therefore \text{ \% purity } = \frac{1.96}{3.92} \times 100 = 50\%$$

6. (c) : From given information,

$$Q = \tan 75^\circ = \frac{\text{Conc. of } iso\text{-butane}}{\text{Conc. of } n\text{-butane}} = 3.73$$

Given $K_c = 1.732 \Rightarrow Q > K_c$

So, the given reaction will go in the backward direction till it attains equilibrium.

7. (a) : $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

8. (a) : Higher the value of $(n + l)$, higher is the energy. For same value of $(n + l)$ energy will be decided by the value of 'n'. Lower value of n implies low energy.

	(i)	(ii)	(iii)	(iv)
$(n + l)$:	(4 + 1)	(4 + 0)	(3 + 2)	(3 + 1)
	= 5	= 4	= 5	= 4

Therefore, the correct order is the following :

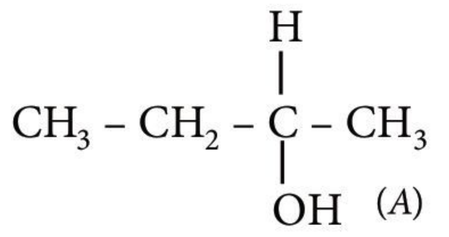
(iv) < (ii) < (iii) < (i)

9. (a) : Since atomic size increases, ionisation potential decreases.

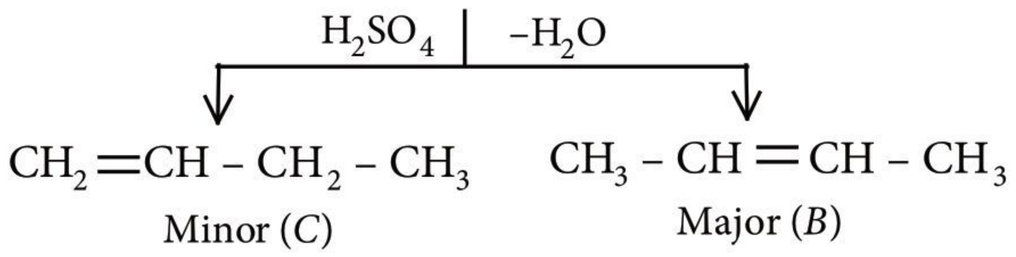
10. (c) : A reaction, in which a substance undergoes simultaneous oxidation and reduction, is called disproportionation reaction. In such reactions, the same substance simultaneously acts as an oxidising agent and as a reducing agent. Here, Cl undergoes simultaneous oxidation and reduction.

$$\overset{0}{2KOH} + \overset{}{Cl_2} \rightarrow \overset{-1}{KCl} + \overset{+1}{KOCl} + H_2O$$

11. (b) :



(Two enantiomeric forms)

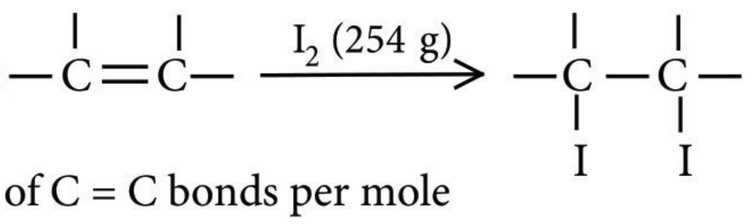


Minor (*C*) Major (*B*)

(*B*) will give (*A*) again. Addition in (*C*) will occur against Markownikoff's rule. Hence (*C*) will give isomer of (*A*) *i.e.*, it will form butan-1-ol.

12. (d) : KCl will be soluble and CuS will be precipitated.

13. (d)

14. (c) : 

Number of C = C bonds per mole

$$= \frac{4.76}{5} \times 1600 \times \frac{1}{254} = 6$$

Iodine number is the grams of iodine which reacts with 100 g of fat, and it is $\frac{4.76}{5} \times 100 = 95.2$ g

15. (a) : In the following reaction, H_2O_2 acts as a reducing agent.

$PbO_{2(s)} + H_2O_{2(aq)} \rightarrow PbO_{(s)} + H_2O_{(l)} + O_{2(g)}$

◈ ◈

MONTHLY TEST DRIVE CLASS XII ANSWER KEY

1.	(c)	**2.**	(a)	**3.**	(a)	**4.**	(a)	**5.**	(b)
6.	(b)	**7.**	(c)	**8.**	(a)	**9.**	(d)	**10.**	(d)
11.	(b)	**12.**	(d)	**13.**	(a)	**14.**	(a)	**15.**	(a)
16.	(b)	**17.**	(b)	**18.**	(c)	**19.**	(b)	**20.**	(a,b,c)
21.	(a,b,c)	**22.**	(a,b,d)	**23.**	(a,b,d)	**24.**	(0)	**25.**	(0.74)
26.	(6)	**27.**	(d)	**28.**	(a)	**29.**	(c)	**30.**	(b)

MONTHLY TEST DRIVE

Practice Paper

XI

This specially designed column enables students to self analyse their extent of understanding the complete syllabus. Give yourself four marks for each correct answer and deduct one mark for each wrong answer. Self check table given at the end will help you to check your readiness.

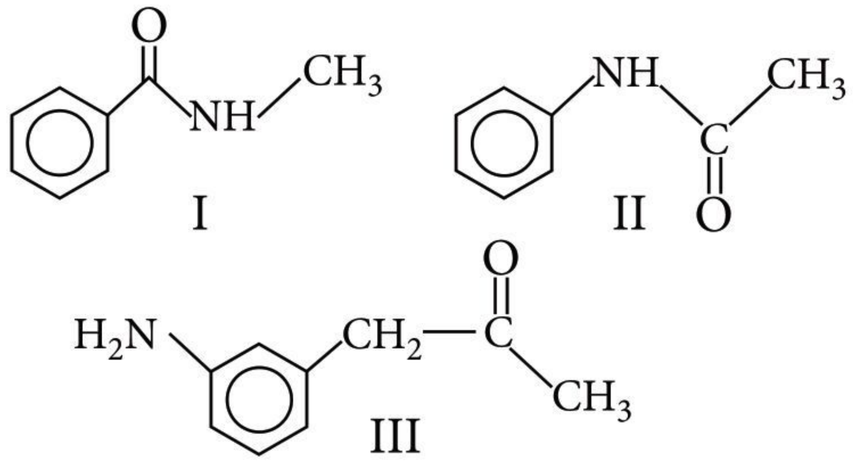
Total Marks : 120 **Time Taken : 60 Min.**

NEET

Only One Option Correct Type

1. Which of the following decreases on going gradually from Be to Ba (in periodic table)?
(a) Basic character of hydroxides
(b) Solubility of sulphates in water
(c) Solubility of hydroxides in water
(d) Strength of elements as reducing agent

2. The decreasing order of electron density on the ring is :



(a) III > II > I (b) II > III > I
(c) I > III > II (d) III > I > II

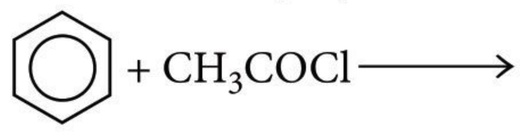
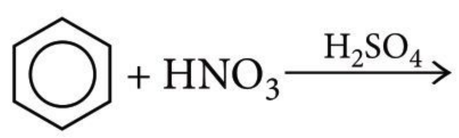
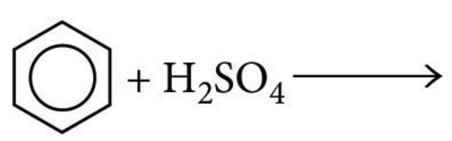
3. 25 mL of 0.50 M H_2O_2 solution is added to 50 mL of 0.20 M $KMnO_4$ in acid solution. Which of the following statements is true?
(a) 0.010 mole of oxygen is liberated.
(b) 0.005 mole of $KMnO_4$ are left.
(c) 0.030 g atom of oxygen gas is evolved.
(d) 0.0025 mole H_2O_2 does not react with $KMnO_4$.

4. A 22 g chunk of dry ice is placed in an empty 600 mL tightly closed vessel at 25°C. What would be the final pressure inside the vessel if all CO_2 gets evaporated ?
(a) 20.4 atm (b) 19.4 atm
(c) 3.71 atm (d) 21.4 atm.

5. The correct electron affinity order of N, O, S, Cl is :
(a) O < N < Cl < S (b) Cl > O > S > N
(c) N < O < S < Cl (d) N = Cl > O = S

6. Hydrogen is not obtained when zinc reacts with
(a) steam (b) hot NaOH solution
(c) conc.H_2SO_4 (d) dilute HCl.

7. 8 litre of H_2 and 6 litre of Cl_2 are allowed to react to maximum possible extent. Find out the final volume of reaction mixture. (Suppose P and T remains constant throughout the course of reaction).
(a) 7 litre (b) 14 litre
(c) 2 litre (d) None of these

8. In which reaction, polysubstitution takes place :
(a)  + $CH_3COCl \longrightarrow$
(b)  + $CH_3Cl \longrightarrow$
(c)  + $HNO_3 \xrightarrow{H_2SO_4}$
(d)  + $H_2SO_4 \longrightarrow$

9. Which of the following is non-existent according to molecular orbital theory?
(a) H_2^- (b) O_2^- (c) He_2 (d) O_2^+

10. The conditions favourable for the reaction, are

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}; \Delta H^\circ = -198 \text{ kJ}$$

(a) low temperature, high pressure
(b) any value of T and P
(c) low temperature and low pressure
(d) high temperature and high pressure.

11. For an isothermal, reversible expansion of an ideal gas
(a) $\Delta S_{System} > \Delta S_{Surrounding}$
(b) $\Delta S_{System} < \Delta S_{Surrounding}$
(c) $\Delta S_{System} = \Delta S_{Surrounding}$
(d) $\Delta S_{System} = -\Delta S_{Surrounding}$.

12. Ozone layer of upper atmosphere is being destroyed by
(a) chlorofluorocarbon
(b) SO_2
(c) photochemical oxidants/O_2 and CO_2
(d) smog.

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** 1/4th of the gas is expelled in air present in an open vessel is heated from 27°C to 127°C.
Reason : Rate of diffusion of a gas is inversely proportional to the square root of its molecular mass.

14. **Assertion :** Helium has the highest value of ionisation energy among all the elements known.
Reason : Helium has the highest value of electron affinity among all the elements known.

15. **Assertion :** Hydrogen shows resemblance with alkali metals as well as halogens.
Reason : Hydrogen exists in atomic form only at high temperature.

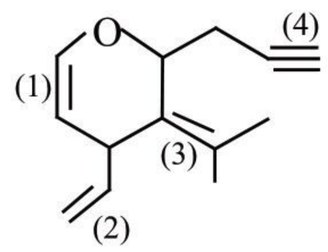
JEE MAIN / JEE ADVANCED

Only One Option Correct Type

16. Methanides are
(a) Mg_2C_3, Be_2C, Al_4C_3 and CaC_2
(b) Mg_2C_3, Be_2C and Al_4C_3
(c) Be_2C, Al_4C_3 and CaC_2
(d) Be_2C and Al_4C_3

17. 100 mL of 0.02 M benzoic acid ($pK_a = 4.2$) is titrated using 0.02 M NaOH. pH after 50 mL and 100 mL of NaOH have been added are
(a) 3.50, 7 (b) 4.2, 7
(c) 4.2, 8.1 (d) 4.2, 8.25

18. The correct reactivity order of following C = C/C ≡ C bonds towards Br^+ is



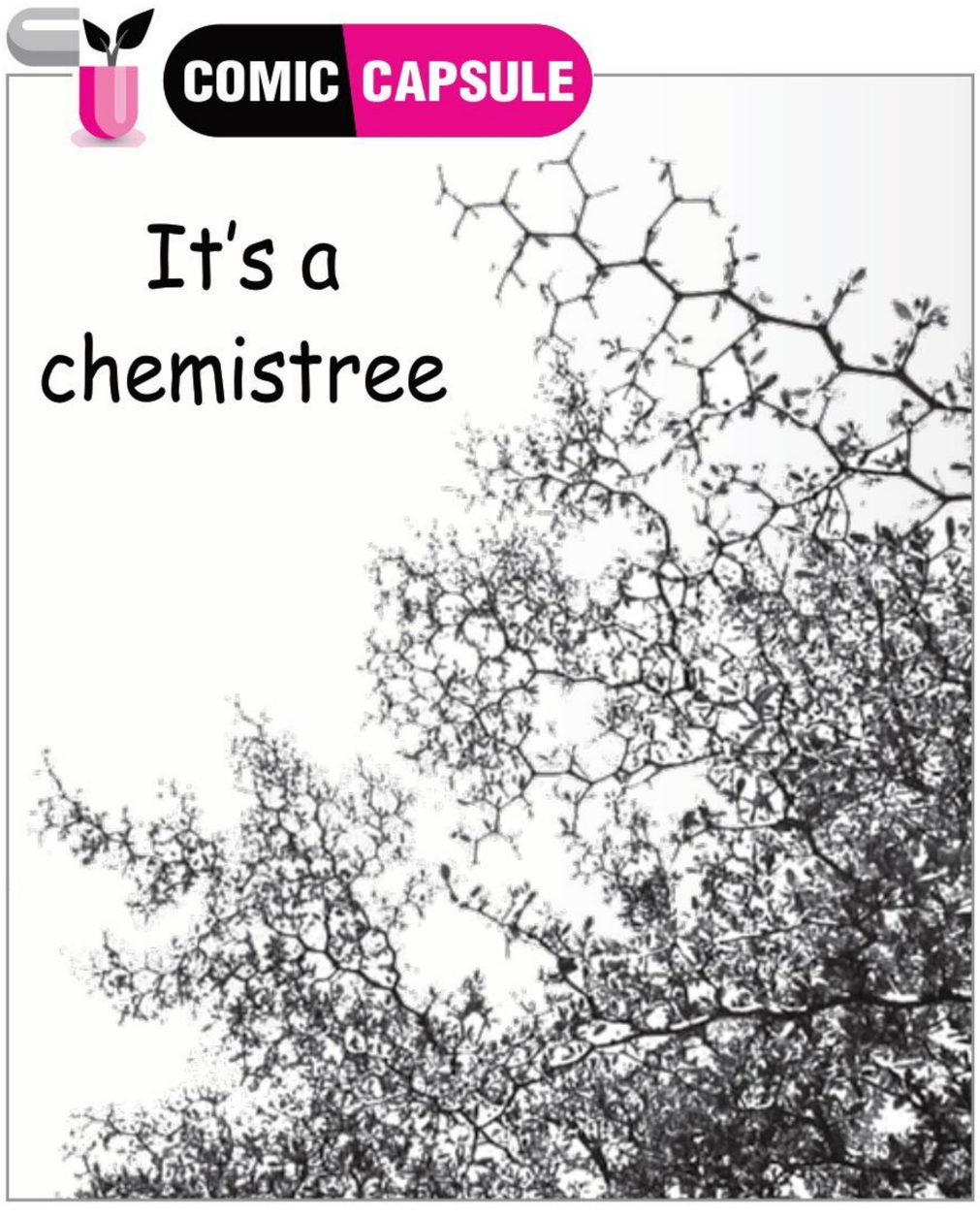
(a) 4 > 3 > 2 > 1 (b) 3 > 2 > 1 > 4
(c) 1 > 3 > 4 > 2 (d) 1 > 3 > 2 > 4

19. Aqueous solution containing 1 mol of borax reacts with 2 mol of acids. This is because of
(a) formation of 2 mol of $B(OH)_3$ only
(b) formation of 2 mol of $[B(OH)_4]^-$ only
(c) formation of 1 mol each of $B(OH)_3$ and $[B(OH)_4]^-$
(d) formation of 2 mol each of $[B(OH)_4]^-$ and $B(OH)_3$, of which only $[B(OH)_4]^-$ reacts with acid.

More than One Option Correct Type

20. Let the colour of the indicator HIn (colourless) will be visible only when its ionised form (pink) is 25% or more in a solution. Suppose HIn ($pK_a = 9.0$) is added to a solution of pH = 9.6, predict what will happen? (Take log 2 = 0.3)
(a) Pink colour will be visible.
(b) Pink colour will not be visible.
(c) % of ionised form will be less than 25%.
(d) % of ionised form will be more than 25%.

COMIC CAPSULE



21. Choose the correct statements.

(a) If w_1 g of the 'X' combines with w_2 g of Cl then the equiv. wt. of $X = \frac{w_1}{w_2} \times 35.5$.

(b) If metallic zinc or iron be added to a solution of silver nitrate or copper sulphate, finely divided silver or copper is precipitated, then $\frac{\text{wt. of Zn (or wt. of Fe)}}{\text{wt. of Ag}}$

$= \frac{\text{equiv. wt. of Zn (or equiv. wt. of Fe)}}{\text{equiv. wt. of Ag}}$.

(c) If w_1 g of the element 'X' combines with w_2 g of Cl then the equiv. wt. of $X = \frac{w_2}{w_1} \times 35.5$

(d) If metallic zinc or iron be added to a solution of silver nitrate or copper sulphate is precipitated, then $\frac{\text{wt. of Ag}}{\text{wt. of Zn (wt. of Fe)}}$

$= \frac{\text{equiv. wt. of Zn / (equiv. wt. of Fe)}}{\text{equiv. wt. of Ag}}$.

22. Polarization is the distortion of the shape of anion by an adjacently placed cation. Which of the following statements is not correct ?

(a) Minimum polarization is brought about by a cation of low radius.

(b) A large cation is likely to bring about a large degree of polarization.

(c) A small anion is likely to undergo a large degree of polarization.

(d) Maximum polarization is brought about by a cation of high charge.

23. Correct statements regarding the dissolution of alkaline earth metals in liquid NH_3 is

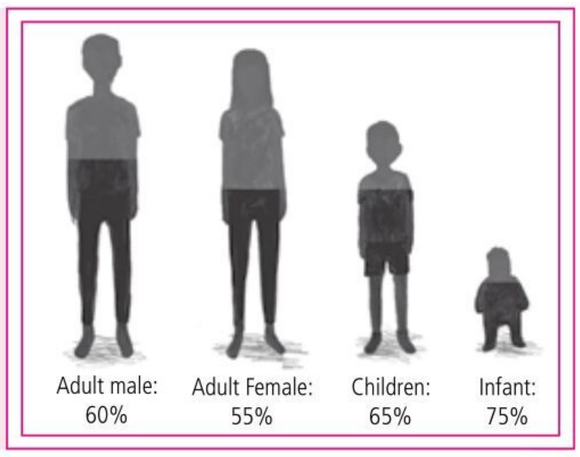
(a) due to high L.E. and I.E, Be and Mg do not dissolve in liquid NH_3

(b) deep blue color is due to absorption spectrum of solvated electron

3 Amazing Facts You Must Know

1. Water content is more in infant than in adults.

Adult humans are typically made up of approximately 60% water, however, at birth, we consist of nearly 75% water. After one year, the water content drops to 65%, and as the child ages, it stabilises at 60%.



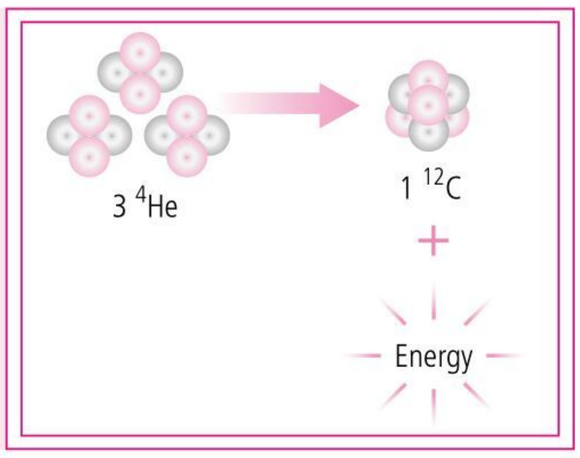
2. Have you ever tasted chalk?

Chalk is an essential part of childhood, from school to playing on the sidewalk, and surely you've tasted it at some point. It wasn't very good, was it? It's pretty damn dry, and this may have something to do with its makeup: it's made of trillions of fossilized plankton.

Chalk is made of the calcareous remains of zillions of microscopic fossil plankton (either coccolithophors or foraminifera). The normal colour is white, and yes, it was once used to make chalk for chalkboards. Today most chalkboard and sidewalk chalk is made from gypsum.

3. Origin of carbon.

Though carbon is everywhere, even inside of stars, it was not produced by the Big Bang. Instead, carbon atoms are produced by helium atoms which are fused together during the formation of red giants by dying stars. The core of a red giant is compressed, and compressed until, at last, the forces are strong enough to begin fusing helium nuclei together to form larger atoms such as carbon.



(c) solution conducts electricity at all concentration
(d) solution remains paramagnetic at all concentration.

Integer / Numerical Value Type

24. One mole of anhydrous salt *AB* dissolves in water and liberates 21.0 J mol^{-1} of heat. The value of $\Delta H_{(hydration)}$ of *AB* is –29.4 J mol^{-1}. The heat of dissolution of hydrated salt, $AB.2H_2O_{(s)}$ is_____.

25. If an electron is present in $n = 6$ level. How many spectral lines would be observed in case of H atom?

26. The number of geometrical isomers of 2,4-hexadiene are_____.

Comprehension Type

Markownikoff's rule states, "the negative part of addendum is added on the carbon atom carrying lesser number of hydrogen atoms"

$$\underset{\text{Unsymmetrical Alkene}}{R-CH=CH_2} + \overset{\delta^+}{H}-\overset{\delta^-}{X} \longrightarrow \underset{\text{Alkyl halide}}{R-\underset{\displaystyle X}{\underset{|}{CH}}-CH_3}$$

However, addition of HBr on propylene in the presence of sunlight, air or an organic peroxide produces mainly *n*-propyl bromide instead of isopropyl bromide. In the presence of organic peroxides, addition of HBr takes place by a free radical mechanism.

27. Addition of HCl on $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH=CH_2$ forms the following major product

(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_3$

(b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2Cl$

(c) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CCl}}-CH_2-CH_3$

(d) $Cl-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_3$

28. Reaction of $CH_3CH=CH_2$ with $Br.CCl_3$ in the presence of a peroxide yields the following product.

(a) $CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_2-CCl_3$

(b) $CH_3-\underset{\displaystyle CCl_3}{\underset{|}{CH}}-CH_2Br$

(c) $BrCH_2-CH_3$ and $CHCl_3$

(d) No reaction takes place.

Matrix Match Type

29. Match the List-I with List-II and select the correct answer using the codes given below in the list. (*n*, *l* and *m* are respectively the principal, azimuthal and magnetic quantum number)

	List I		**List II**
P.	Number of value of *l* for an energy level (*n*)	1.	0, 1, 2, ... $(n-1)$
Q.	Value of *l* for a particular type of orbit	2.	$+l$ to $-l$ through zero
R.	Number of value of *m* for $l = 2$	3.	5
S.	Value of '*m*' for a particular type of orbital	4.	*n*

	P	**Q**	**R**	**S**
(a)	4	1	2	3
(b)	4	1	3	2
(c)	1	4	2	3
(d)	1	4	3	2

30. Match the List-I with List-II and select the correct option.

	List-I		**List-II**
P.	Na^+	1.	Violet
Q.	Ba^{2+}	2.	Crimson-red
R.	K^+	3.	Apple-green
S.	Sr^{2+}	4.	Golden yellow

	P	**Q**	**R**	**S**
(a)	1	2	4	3
(b)	2	1	3	4
(c)	4	1	2	3
(d)	4	3	1	2

Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

GET SET GO for JEE

with exclusive and brain storming MCQs

Practicing these MCQs help to strengthen your concepts and give you extra edge in your JEE preparation

A hypothetical reaction: $A_2 + B_2 \rightarrow 2AB$ follows the mechanism as given below:

$A_2 \rightleftharpoons A + A$ (fast reaction)

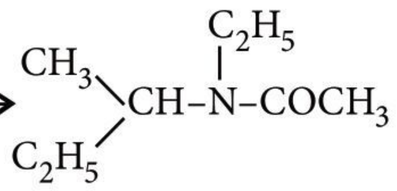
$A + B_2 \rightarrow AB + B$ (slow reaction)

$A + B \rightarrow AB$ (fast reaction)

1. The rate law of the equation is

(a) rate = $K[A_2][B_2]$ (b) rate = $K[A_2]^2[B_2]$

(c) rate = $K[A_2]^{1/2}[B_2]$ (d) rate = $K[A_2][B_2]^{1/2}$

2. $CO_2 + A \longrightarrow B \xrightarrow{P_2O_5} C \xrightarrow{D}$ 

Which of the following are *A* and *D* in the above series of reactions?

(a) C_2H_5MgX and $(C_2H_5)_2NCH_3$

(b) C_2H_5MgX and $(CH_3)_2NC_2H_5$

(c) C_2H_5MgX and *N*-methyl-2-butanamine

(d) CH_3MgX and *N*-ethyl-2-butanamine

3. Which compound can exist in a dipolar (zwitter ion) structure?

(a) $C_6H_5CH_2CH(N=CH_2)COOH$

(b) $(CH_3)_2CHCH(NH_2)COOH$

(c) $C_6H_5CONHCH_2COOH$

(d) $HOOCCH_2CH_2COCOOH$.

4. Which of the following are incorrect?

	Crystal system	Axial distance	Axial angles	Examples
(1)	Cubic	$a \neq b = c$	$\alpha = \beta \neq \gamma = 90°$	Cu, KCl
(2)	Mono-clinic	$a \neq b = c$	$\alpha = \beta = \gamma = 90°$	$PbCrO_2$, $PbCrO_4$
(3)	Triclinic	$a = b = c$	$\alpha \neq \beta = \gamma \neq 90°$	$K_2Cr_2O_7$, $CuSO_4 \cdot 5H_2O$
(4)	Rhombo-hedral	$a = b = c$	$\alpha = \beta = \gamma \neq 90°$	$CaCO_3$, $NaNO_3$

(a) 1, 2 and 3 (b) 1 and 2

(c) 2 and 4 (d) 1 and 3

5. In nitrogen family, the H–*M*–H bond angle in the hydrides gradually becomes closer to 90° on going form N to Sb. This shows that gradually

(a) the basic strength of the hydrides increases

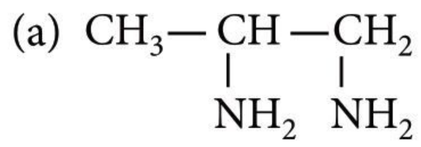
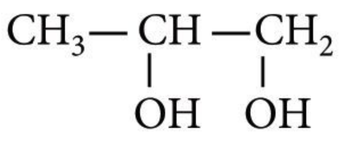
(b) almost pure *p*-orbitals are used for *M*–H bonds

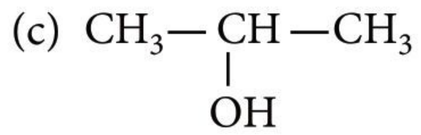
(c) the bond energies of *M*–H bonds increase

(d) the bond pairs of electrons become nearer to the central atom.

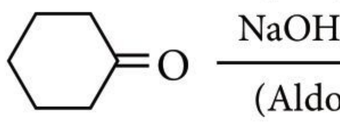
6. In the following series of chemical reactions, identify *Z*.

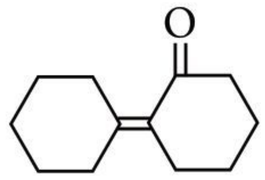
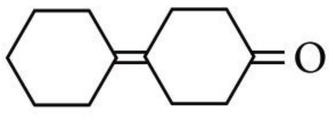
$$C_3H_7OH \xrightarrow[160°-180°C]{Conc.H_2SO_4} X \xrightarrow{Br_2} Y \xrightarrow[alc.KOH]{Excess\ of} Z$$

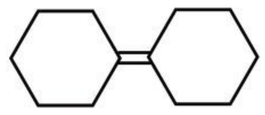
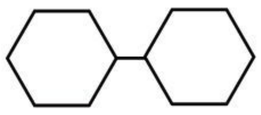
(a)  (b) 

(c)  (d) $CH_3C \equiv CH$

7. Alizarin dye obtained from the root of madder plant is anthraquinone derivative. Its structure corresponds to
(a) 1,2-dihydroxyanthraquinone
(b) 2,3-dihydroxyanthraquinone
(c) 1,4-dihydroxyanthraquinone
(d) 1,1′-dihdryoxyanthraquinone.

8.  $\xrightarrow[\text{(Aldol)}]{\text{NaOH, }\Delta}$ *A*. Product '*A*' is

(a)  (b) 

(c)  (d) 

9. Arrange the following ions in their decreasing order of magnetic moment.
(i) V^{4+} (ii) Mn^{4+} (iii) Fe^{3+} (iv) Ni^{2+}
[At. No. V = 23, Mn = 25, Fe = 26, Ni = 28]
(a) (ii) > (iii) > (i) > (iv)
(b) (iii) > (iv) > (ii) > (i)
(c) (iii) > (ii) > (iv) > (i)
(d) (ii) > (iii) > (iv) > (i)

10. Oils and fats are obtained by saponification of potassium stearate. Its formula is $CH_3—(CH_2)_{16}—COO^-K^+$. Lyophobic end of atom is (CH_3)— and lyophilic end is $—COO^-K^+$. Potassium stearate is an example of
(a) lyophobic colloids (b) lyophilic colloids
(c) poly molecular colloids
(d) associated colloids or micelles.

NUMERICAL PROBLEMS

11. A sample of wustite, Fe_xO_y, contains one Fe(III) for every three Fe(II). Calculate the value of *x*.

12. Rate constant of a first order reaction is 1.15×10^{-5} sec^{-1}. The percentage of initial concentration remained after 1 hour is_____.

13. If equivalent conductance of 1 M benzoic acid is 12.8 ohm^{-1} $cm^2(g.eq)^{-1}$ and conductance of benzoate ion and H^+ ion are 42 and 288.42 $ohm^{-1}cm^2$ $(g.eq)^{-1}$ respectively, then its percentage degree of dissociation is _____.

14. The average person can see the red colour imparted by the complex $[Fe(SCN)]^{2+}$ to an aqueous solution if the concentration of the complex is 6×10^{-6} M or greater. If the minimum concentration of KSCN required to make it possible to detect 1 ppm (part per million) of Fe(III) in a natural water sample is 3.6×10^{-x}M, then find the value of *x*.
The instability constant for
$[Fe(SCN)^{2+}] \rightleftharpoons Fe^{3+} + SCN^-$ is 7.142×10^{-3}

15. Tropic acid (obtained from the alkaloid atropine), $C_9H_{10}O_3$, gives a positive CrO_3/H_2SO_4 test and is oxidised by hot $KMnO_4$ to benzoic acid. Tropic acid is converted by the following sequence of reactions into hydratropic acid.

$$\text{Tropic acid} \xrightarrow{HBr} (C_9H_9O_2Br) \xrightarrow{OH^-} (C_9H_8O_2)\text{(Atropic acid)}$$

$$\text{Atropic acid} \xrightarrow{H_2,Ni} \text{Hydratropic acid}(C_9H_{10}O_2)$$

No. of carbon atoms in the ring in tropic acid is_____.

SOLUTIONS

1. (c) : Slowest step is rate determining.
Rate = $k\,[A]\,[B_2]$ ... (i)

$$K_C = \frac{[A][A]}{[A_2]} = \frac{[A]^2}{[A_2]}$$

From (i), rate = $k \cdot K_C^{1/2}[A_2]^{1/2}\,[B_2]$
$= K\,[A_2]^{1/2}\,[B_2]$ (where $K = k \cdot K_C$)

2. (d) : $CO_2 + \underset{(A)}{CH_3MgX} \xrightarrow{H_2O} \underset{(B)}{CH_3COOH}$

$$\xrightarrow[-H_2O]{P_2O_5} \underset{(C)}{(CH_3CO)_2O} \xrightarrow[(D)]{CH_3-\underset{\displaystyle NH-C_2H_5}{\underset{|}{CH}}-C_2H_5} \begin{matrix} C_2H_5 \\ CH_3 \end{matrix} \!\!>\!\! CH-\underset{\displaystyle C_2H_5}{\underset{|}{N}}-COCH_3$$

3. (b) : α-Amino acids exist as zwitter ion.

$$(CH_3)_2CH-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH \longrightarrow (CH_3)_2CH-\underset{\displaystyle {}^+NH_3}{\underset{|}{CH}}-COO^-$$

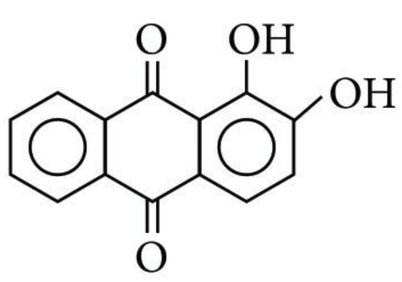
Zwitter ion

4. (a) : Rhombohedral crystal system
$a = b = c$, $a = b = \gamma \neq 90°$
Examples : $CaCO_3$, $NaNO_3$
Thus, (a), (b) and (c) are incorrect.

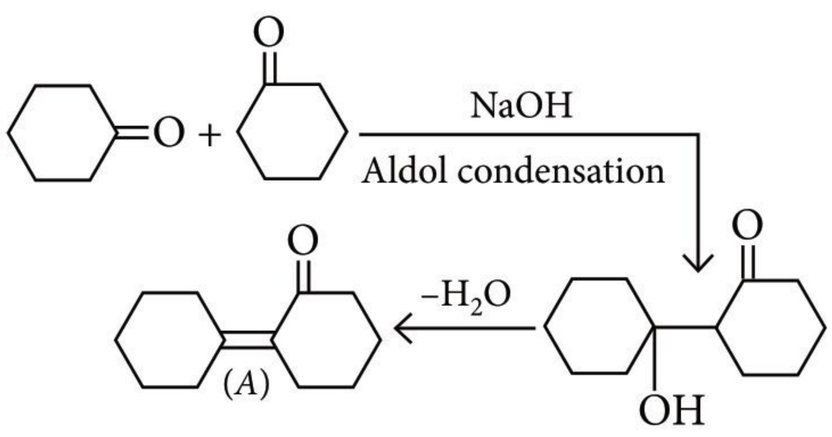
5. (b) : On moving down the group, electronegativity decreases, consequently bond pair shifts more and more away from the central atom. Hence, H–*M*–H bond angle decreases and becomes closer to 90° in SbH_3, which reveals that almost pure *p*-orbitals are used for *M*–H bonding.

6. (d): $CH_3CH_2CH_2OH \xrightarrow[160°-180°C]{Conc.H_2SO_4} \underset{(X)}{CH_3-CH=CH_2} \xrightarrow{Br_2} \underset{\substack{| \quad | \\ Br \quad Br \\ (Y)}}{CH_3-CH-CH_2} \xrightarrow{alc.KOH} \underset{\substack{(Z) \\ \text{Propyne}}}{CH_3-C\equiv CH}$

7. (a): Alizarin is 1, 2-dihydroxyanthraquinone *i.e.*,



8. (a):



9. (c): More the number of unpaired electrons, more will be the magnetic moment. Since V^{4+}, Mn^{4+}, Fe^{3+} and Ni^{2+} have 1, 3, 5 and 2 unpaired electrons respectively, their magnetic moment will be in following order:
$Fe^{3+} > Mn^{4+} > Ni^{2+} > V^{4+}$.

10. (d): The substances whose molecules associate with given solvent to form colloidal particles are known as associated colloids. The molecules of soaps and detergents are generally smaller than colloidal particles those molecules associate in concentrated solution to form colloidal size particles. These association of soap and detergent molecules are known as micelles.

11. (8): Let there be 1 mol of iron atom.
Amount of Fe (III) = (1/4) mol ;
Amount of Fe (II) = (3/4) mol
Total positive charges = (1/4)(3) + (3/4)(2) = (9/4)
Let n be the amount of oxygen atoms.
Total negative charges = $2n$
To satisfy electrical neutrality,
Total positive charges = Total negative charges

$$\frac{9}{4}\text{mol} = 2n \Rightarrow n = \frac{9}{8}\text{mol}$$

Hence, composition of the compound is $FeO_{9/8}$ or Fe_8O_9.
$\therefore \quad x = 8$

12. (95.96): $1.15 \times 10^{-5} = \dfrac{2.303}{1\times60\times60} \log \dfrac{a}{a-x}$

(Time = 1 hour = 1 × 60 × 60 seconds)

$$\log \frac{a}{a-x} = \frac{1.15 \times 10^{-5} \times 1 \times 60 \times 60}{2.303} = 0.0179$$

$$\frac{a}{a-x} = 1.042 \Rightarrow \frac{a-x}{a} = \frac{1}{1.042} = 0.9596$$

Percentage of reactant remained = 0.9596 × 100 = 95.96 %

13. (3.87): $\Lambda^{\infty}_{m(C_6H_5COOH)} = \Lambda^{\infty}_{(C_6H_5COO^-)} + \Lambda^{\infty}_{(H^+)}$
$= 42 + 288.42 = 330.42$

$$\alpha = \frac{\Lambda^c_m}{\Lambda^{\infty}_m} = \frac{12.8}{330.42} = 0.0387$$

$\therefore$ Percentage degree of dissociation = 3.87%

14. (3): $K = \dfrac{10^3}{7.142}$

	Fe^{3+}	+	SCN^-	$\rightleftharpoons$	$[Fe(SCN)]^{2+}$
Initial conc.	$\frac{10^{-3}}{56}$		b		0
Final conc.	$\frac{10^{-3}}{56} - 6\times10^{-6}$		$b - 6\times10^{-6}$		6×10^{-6}

On solving, b = 0.0036 M.

15. (6)

CBSE TERM-II

SOLVED PAPER 2022

Held on **7th May**

CLASS **12**

General Instructions : Read the following instructions very carefully and strictly follow them :

Time Allowed : 2 Hours
Maximum Marks : 35

1. *This question paper contains 12 questions. All questions are compulsory.*
2. *This question paper comprises of three sections, Section - A, B and C.*
3. *Section A - Q. No. 1 to 3 are very short-answer type questions carrying 2 marks each.*
4. *Section B - Q. No. 4 to 11 are short-answer type questions carrying 3 marks each.*
5. *Section C - Q. No. 12 is case based question carrying 5 marks.*
6. *Use of log tables and calculator is not allowed.*

SECTION - A

1. In a plot of Λ_m against the square root of concentration ($C^{1/2}$) for strong and weak electrolyte, the value of limiting molar conductivity of a weak electrolyte cannot be obtained graphically. Suggest a way to obtain this value. Also state the related law, if any.

2. Write reasons for the following statements :

(i) Benzoic acid does not undergo Friedel-Crafts' reaction.

(ii) Oxidation of aldehydes is easier than that of ketones.

3. Give reasons for the following statements : (Any **two**)

(i) Benzaldehyde is less reactive than propanal in nucleophilic addition reactions.

(ii) Carboxylic acids do not give reactions of carbonyl group.

(iii) 4-Nitrobenzoic acid is a stronger acid than benzoic acid.

SECTION - B

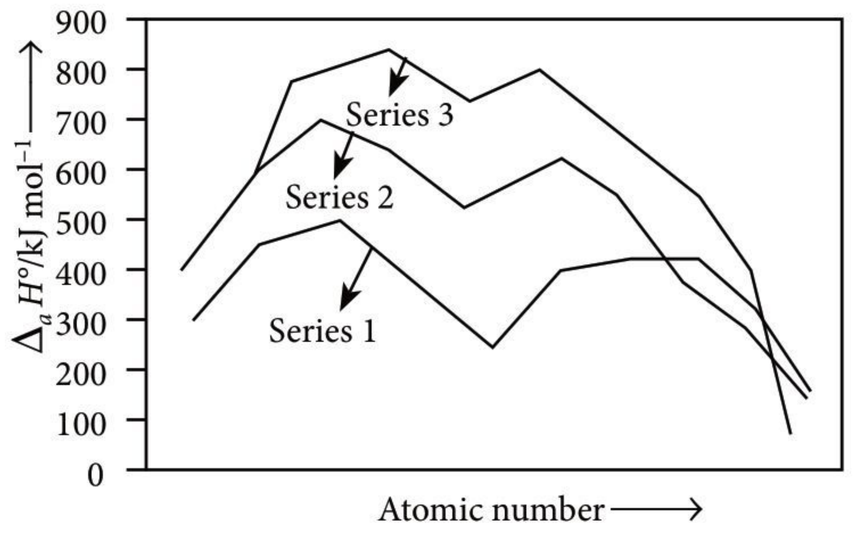
4. **(a)** **(i)** Silver atom has completely filled *d*-orbitals in its ground state, it is still considered to be a transition element. Justify the statement.

(ii) Why are $E^{\circ}_{M^{2+}/M}$ values of Mn and Zn more negative than expected?

(iii) Why do transition metals form alloys?

OR

(b) Answer the following questions on the basis of the figure given below :



(i) Which element in 3*d* series has lowest enthalpy of atomisation?

(ii) Why do metals of the second and third series have greater enthalpies of atomisation?

(iii) Why are enthalpies of atomisation of transition metals quite high?

5. **(a)** **(i)** Write the electronic configuration of d^4 on the basis of crystal field splitting theory, if $\Delta_o < P$.

(ii) $[Ni(CN)_4]^{2-}$ with square-planar structure is diamagnetic and $[NiCl_4]^{2-}$ with tetrahedral geometry is paramagnetic. Give reason to support the statement.
[Atomic number : Ni = 28]

(iii) Write the number of ions produced in the solution from the following complex :
$[PtCl_2(NH_3)_4]Cl_2$

OR

(b) (i) Calculate the spin only magnetic moment of the complex $[FeF_6]^{3-}$. (Atomic number of Fe = 26)

(ii) Write the IUPAC name of the given complex : $[Co(NH_3)_5Cl]Cl_2$

(iii) Why is the complex $[Co(en)_3]^{3+}$ more stable than $[CoF_6]^{3-}$?

6. (a) Write equations involved in the following reactions :

(i) Ethanamine reacts with acetyl chloride.

(ii) Aniline reacts with bromine water at room temperature.

(iii) Aniline reacts with chloroform and ethanolic potassium hydroxide.

OR

(b) (i) Write the IUPAC name for the following organic compound :
$(CH_3CH_2)_2NCH_3$

(ii) Write the equations for the following :

(I) Gabriel phthalimide synthesis

(II) Hoffmann bromamide degradation

7. (a) Write reasons for the following :

(i) Ethylamine is soluble in water whereas aniline is insoluble.

(ii) Amino group is *o*- and *p*-directing in aromatic electrophilic substitution reactions, but aniline on nitration gives a substantial amount of *m*-nitroaniline.

(iii) Amines behave as nucleophiles.

OR

(b) How will you carry out the following conversions :

(i) Nitrobenzene to aniline

(ii) Ethanamide to methanamine

(iii) Ethanenitrile to ethanamine?

8. A compound '*A*' (C_2H_4O) on oxidation gives '*B*' ($C_2H_4O_2$). '*A*' undergoes iodoform reaction to give yellow precipitate and reacts with HCN to form the compound '*C*'. '*C*' on hydrolysis gives 2-hydroxypropanoic acid. Identify the compounds '*A*', '*B*' and '*C*'. Write down equations for the reactions involved.

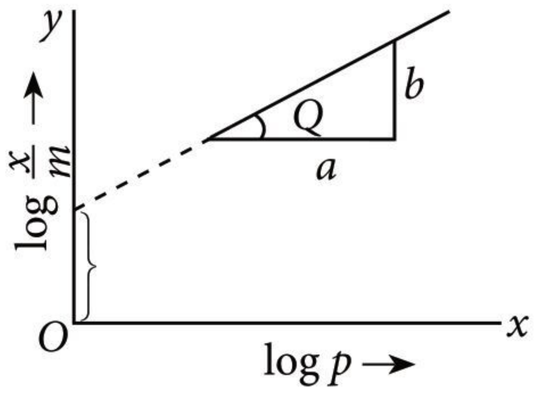
9. (i) Which ion amongst the following is colourless and why?
Ti^{4+}, Cr^{3+}, V^{3+}
(Atomic number of Ti = 22, Cr = 24, V = 23)

(ii) Why is Mn^{2+} much more resistant than Fe^{2+} towards oxidation?

(iii) Highest oxidation state of a metal is shown in its oxide or fluoride only. Justify the statement.

10. Write the Nernst equation and calculate the emf of the following cell at 298 K :
$Zn\,|\,Zn^{2+}\,(0.001\ M)\,||\,H^+\,(0.01\ M)\,|\,H_{2(g)}\,(1\ bar)\,|\,Pt_{(s)}$
Given : $E^\circ_{Zn^{2+}/Zn} = -0.76$ V, $E^\circ_{H^+/H_2} = 0.00$ V,
[log 10 = 1]

11. Observe the given figure and answer the following questions :



(i) Write the expression for adsorption of gases on solids in the form of an equation.

(ii) What is the slope of the graph?

(iii) What does the intercept of the line represent?

SECTION - C

12. Read the passage given below and answer the questions that follow :

The rate law for a chemical reaction relates the reaction rate with the concentrations or partial pressures of the reactants. For a general reaction $aA + bB \rightarrow C$ with no intermediate steps in its reaction mechanism, meaning that it is an elementary reaction, the rate law is given by $r = k[A]^x[B]^y$, where $[A]$ and $[B]$ express the concentrations of *A* and *B* in moles per litre. Exponents *x* and *y* vary for each reaction and are determined experimentally. The value of *k* varies with conditions that affect reaction rate, such as temperature, pressure, surface area, etc. The sum of these exponents is known as overall reaction order. A zero order reactions has constant rate that is independent of the concentration of the reactions. A first order reaction depends on the concentration of only one reactant. A reaction is said to be second order when the overall order is two. Once we have determined the order of the reaction, we can go back and plug in one set of our initial values and solve for *k*.

(i) Calculate the overall order of a reaction which has the following rate expression :
Rate = $k\,[A]^{1/2}\,[B]^{3/2}$

(ii) What is the effect of temperature on rate of reaction?

(iii) What is meant by rate of a reaction?

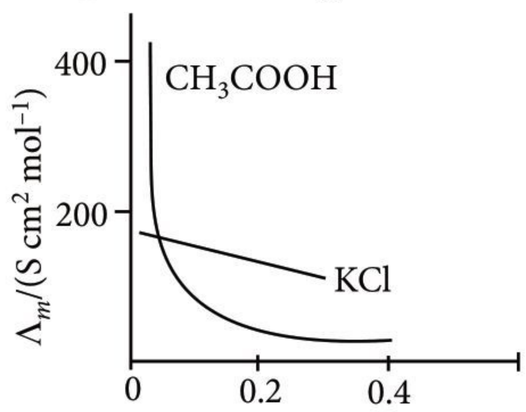
(iv) (a) A first order reaction takes 77.78 minutes for 50% completion. Calculate the time required for 30% completion of this reaction. (log 10 = 1, log 7 = 0.8450)

OR

(b) A first order reaction has a rate constant 1×10^{-3} per sec. How long will 5 g of this reactant take to reduce to 3 g? (log 3 = 0.4771; log 5 = 0.6990)

SOLUTIONS

1. Weak electrolytes like acetic acid have lower degree of dissociation at higher concentrations and hence for such electrolytes, the change in Λ_m with dilution is due to increase in the degree of dissociation. This results in increase in the number of ions in the total volume. In case of weak electrolyte, Λ_m increases steeply on dilution at lower concentrations and does not reach a constant value even at infinite dilution. Therefore Λ°_m cannot be obtained by extrapolation of Λ_m to zero concentration.



Molar conductivity versus $C^{½}$ for acetic acid (weak electrolyte) and potassium chloride (strong electrolyte) in aqueous solution

Λ°_m for such case is obtained by using Kohlrausch law of independent migration of ions. The law states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolytes,

i.e., $\Lambda^\circ_m = \upsilon_+ \lambda^\circ_+ + \upsilon_- \lambda^\circ_-$

2. (i) Due to presence of electron withdrawing or deactivating group (—COOH) and the bonding of carboxyl group with catalyst $AlCl_3$ (lewis acid) in aromatic carboxylic acids, they do not undergo Friedel–Crafts' reaction.

(ii) Unlike aldehydes, ketones do not contain any hydrogen atom attached to $>C=O$ group and hence, they cannot be oxidised without the cleavage of carbon-carbon bonds. Thus, oxidation of aldehydes is easier than ketones.

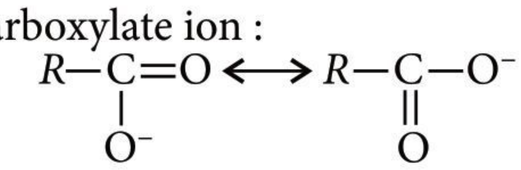
3. (i) Greater the number of alkyl groups attached to the carbonyl group, greater is the electron density on the carbonyl carbon and hence, lower is its reactivity towards nucleophilic addition reactions.

The $+R$ effect of the benzene ring increases the electron density on the carbonyl group thereby repelling the nucleophiles. Hence, aromatic aldehydes are less reactive than the corresponding aliphatic aldehydes.

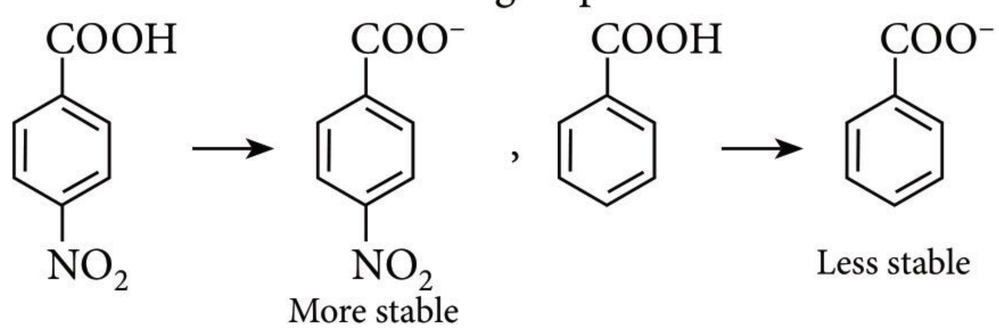
So, the increasing order of reactivity is

$\underset{\text{Benzaldehyde}}{C_6H_5CHO} < \underset{\text{Propanal}}{CH_3CH_2CHO}$

(ii) The carbonyl group in —COOH is inert and does not show nucleophilic addition reaction like carbonyl compounds. It is due to resonance stabilisation of carboxylate ion :



(iii) 4-Nitrobenzoic acid is a stronger acid than benzoic acid because conjugate base obtained from the 4-nitrobenzoic acid is more stable in comparison of conjugate base obtained from benzoic acid. This is due to $-I$ and $-R$ effect of nitro group.



4. (a) (i) Silver atom has outer electronic configuration $4d^{10}\,5s^1$ in its ground state, but silver in +2 oxidation state has electronic configuration $4d^9$. So in +2 oxidation state, silver has incomplete *d*-orbital. Hence, silver is considered as a transition element.

(ii) Mn^{2+} ion has stable half-filled ($3d^5$) electronic configuration whereas Zn^{2+} has completely filled d^{10} configuration. As a result, ionisation enthalpy value is lower in comparison to hydration enthalpy. Hence, $E^\circ_{Mn^{2+}/Mn}$ and $E^\circ_{Zn^{2+}/Zn}$ are more negative than expected.

(iii) Transition metals form alloys because they have similar atomic radii.

OR

4. (b) (i) Enthalpy of atomisation depends on the number of unpaired electrons in the valence shell. Greater the number of valence electrons, stronger is the resultant bonding and higher will be the enthalpy of atomisation. In 3*d* series, zinc has no unpaired electrons in valence shell so, it has lowest enthalpy of atomisation.

(ii) The enthalpies of atomisation of second and third transition series are high because of poor shielding of the electrons in 4*d* and 5*d* orbitals in comparison to

electrons in 3*d* orbital, which results in the stronger metallic bonding.

(iii) Transition metals have high enthalpies of atomisation because of presence of unpaired electrons and poor shielding effect of *d*-orbitals.

5. (a) (i) For d^4 ion, if $\Delta_o < P$, the fourth electron enters one of the e_g orbitals giving the configuration $t_{2g}^3\, e_g^1$. Ligands for which $\Delta_o < P$ are known as weak field ligands and form high spin complexes.

(ii) Due to the presence of weak field ligand, *i.e.*, Cl^- in the complex $[NiCl_4]^{2-}$ two unpaired electrons are present in 3*d*-orbitals of Ni-atom hence, this complex is paramagnetic in nature. On the other hand, due to the presence of strong field ligand *i.e.*, CN^- in the complex $[Ni(CN)_4]^{2-}$, no unpaired electron is present in 3*d*-orbitals of Ni-atom (as strong field ligand causes pairing of electrons), hence, it is diamagnetic in nature.

(iii) $[PtCl_2(NH_3)_4]Cl_2 \rightarrow [PtCl_2(NH_3)_4]^{2+}_{(aq)} + 2Cl^-_{(aq)}$

Hence, the total number of ions produced is three.

OR

(b) (i) $[FeF_6]^{3-}$

Oxidation state of Fe = +3

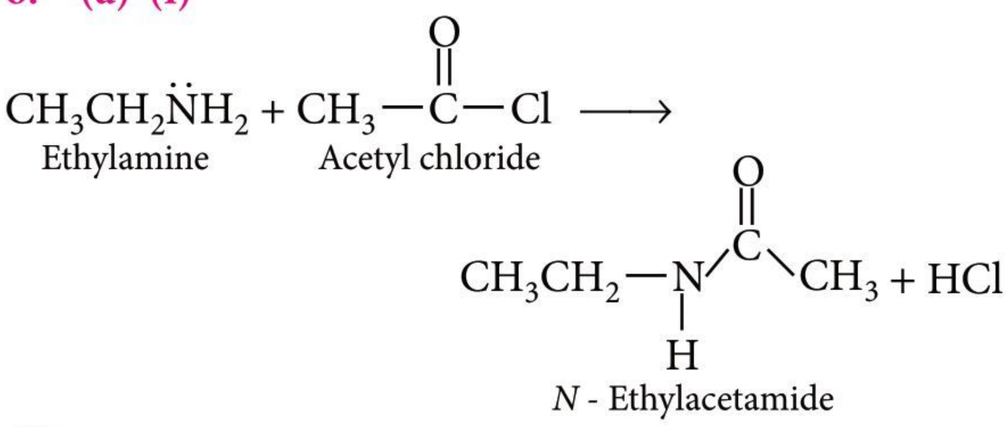
$Fe^{3+} : 3d^5$, ↑ ↑ ↑ ↑ ↑ (3*d*-orbitals)

$\mu_{spin} = \sqrt{n(n+2)}$ B.M $= \sqrt{5(5+2)}$ B.M $= 5.91$ B.M

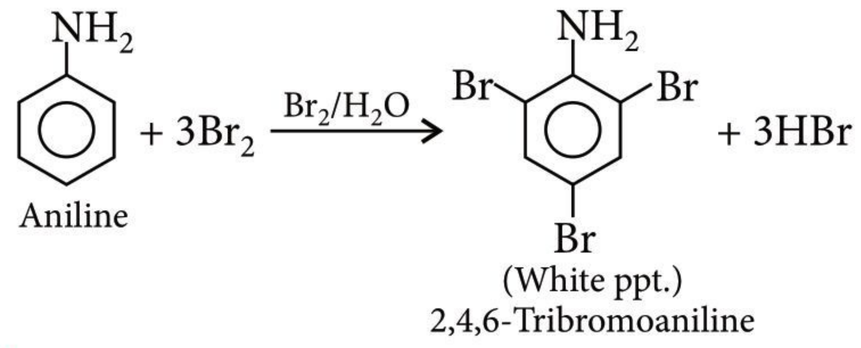
(ii) Pentaamminechloridocobalt(III) chloride

(iii) Chelating ligands form more stable cyclic/ring complexes than unidentate or non-chelating ligands. Since $[Co(en)_3]^{3+}$ contains *en* which is a bidentate chelating ligand, it is more stable than $[CoF_6]^{3-}$

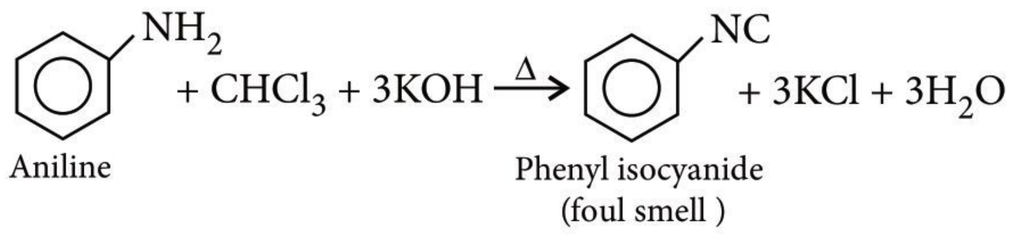
6. (a) (i)



(ii) Aniline gives white precipitates of 2,4,6-tribromo-aniline on reaction with bromine water.



(iii) Aniline react with chloroform and ethanolic KOH to give phenyl isocyanide. This reaction is known as carbylamine reaction.

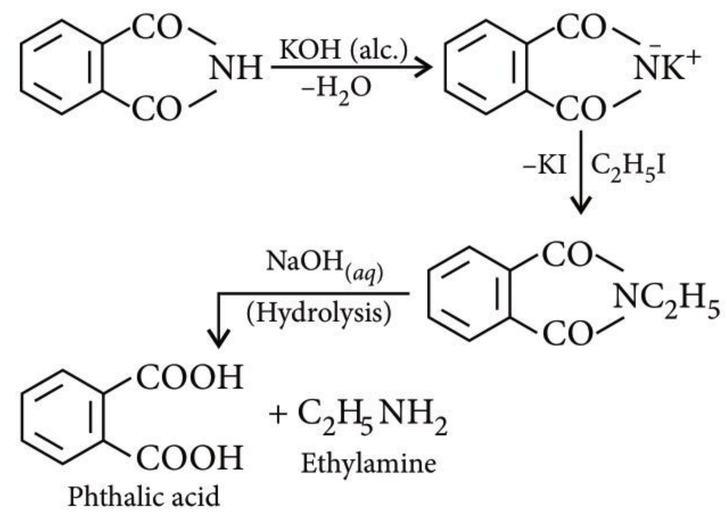


OR

(b) (i) $(H_3CH_2C)_2N—CH_3$

IUPAC name : *N*-Ethyl-*N*-methylethanamine

(i)



(ii) $R—CONH_2 + Br_2 + 4NaOH \longrightarrow$

Alkyl amide

$R—NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

1° amine

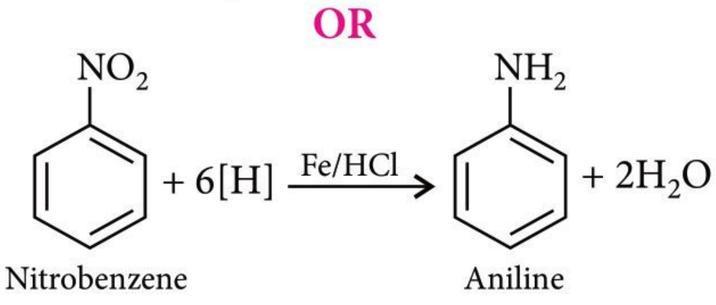
7. (a) (i) Ethylamine forms intermolecular hydrogen bonding with water which makes it soluble in water. Aniline has a hydrophobic part $C_6H_5—$ which makes it insoluble in water.

(ii) Nitration is carried out with conc. HNO_3 in the presence of conc. H_2SO_4. In the presence of these acids, the $–NH_2$ group of aniline gets protonated and is converted into $–\overset{+}{N}H_3$ group. This positively charged group acts as a strong electron withdrawing and *meta*-directing group. Hence, the incoming electrophile goes to *m*-position.

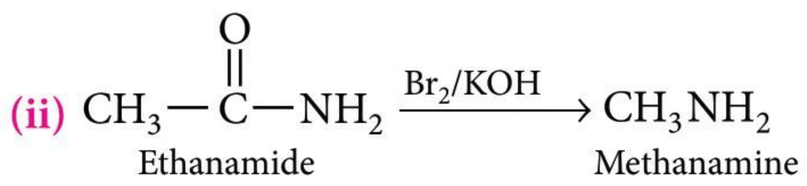
(iii) Amines behave as nucleophiles due to the presence of unshared electron pair.

OR

(b) (i)



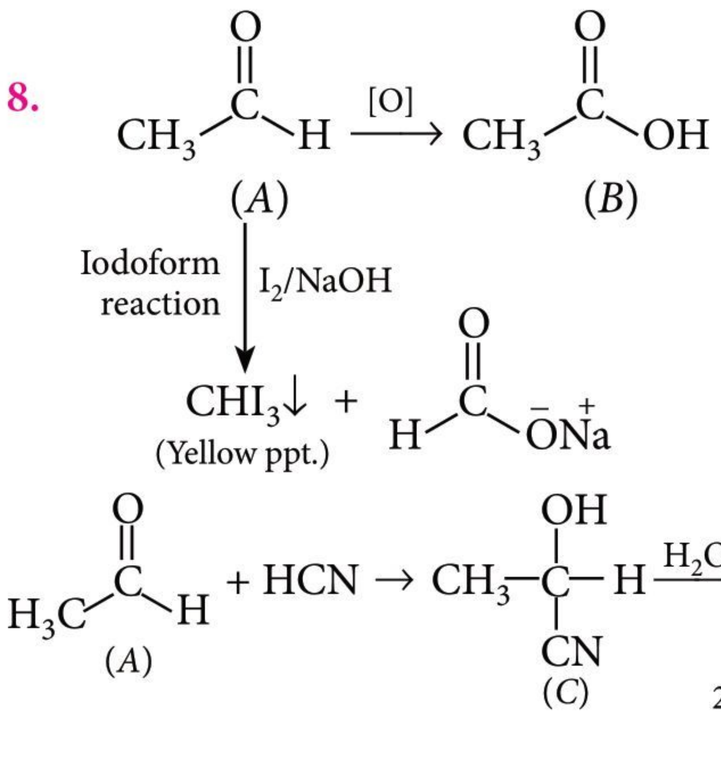
(ii)



(iii) $CH_3CN \xrightarrow{H_2/Ni} CH_3CH_2NH_2$

Ethanenitrile — Ethanamine

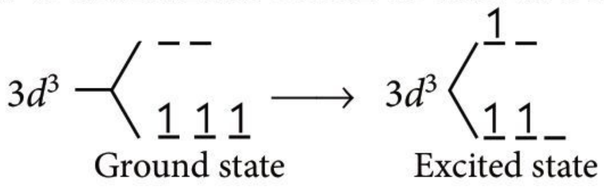
8.



9. **(i)** Colour of transition metal ions is due to the *d-d* transitions. Ions which do not involve in *d-d* transitions are colourless.

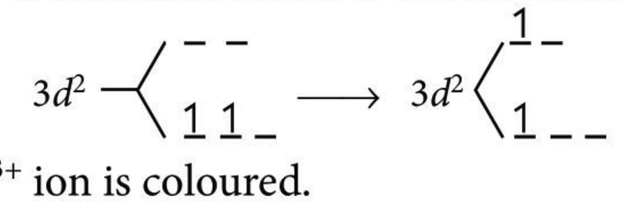
Ti^{4+} : $3d^0 4s^0$, no *d-d* transition, colourless

Cr^{3+} : $3d^3$, *d-d* transitions occur as shown below :



Hence, Cr^{3+} ion is coloured.

V^{3+} : d^2, *d-d* transition occur as shown below :



Hence, V^{3+} ion is coloured.

In other words, the ions having completely empty *d*-orbitals or no vacant *d*-orbitals for transition of electrons are colourless.

(ii) $Mn^{2+}(3d^5) \longrightarrow Mn^{3+}(3d^4)$

More stable — Less stable

Mn^{2+} is more stable in $3d^5$ state, hence shows resistance towards oxidation.

$Fe^{2+}(3d^6) \longrightarrow Fe^{3+}(3d^5)$

Less stable — More stable

Fe^{3+} is more stable hence gets oxidised easily.

(iii) Metal shows highest oxidation state in its oxide or fluoride because fluorine and oxygen stabilise the highest oxidation states of metals. Oxygen also forms multiple bonds with metal which increases the oxidation state of metal.

10. For a general electrochemical reaction,

$$aA + bB \xrightarrow{ne^-} cC + dD$$

Nernst equation can be written as:

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Given cell :

$Zn|Zn^{2+}(0.001\ M)||H^+(0.01\ M)|\ H_{2(g)}\ (1\ bar)\ |\ Pt_{(s)}$

$E^\circ_{cell} = E^\circ_{H^+/H_2} - E^\circ_{Zn^{2+}/Zn}$

$= 0.00\ V - (-0.76\ V) = 0.76\ V$

$$E_{cell} = 0.76\ V - \frac{0.0591}{2} \log \frac{(0.001)}{(0.01)}$$

$= 0.76 - (0.0295) \times (-1)$

$= 0.76 + 0.0295 = 0.7895\ V$

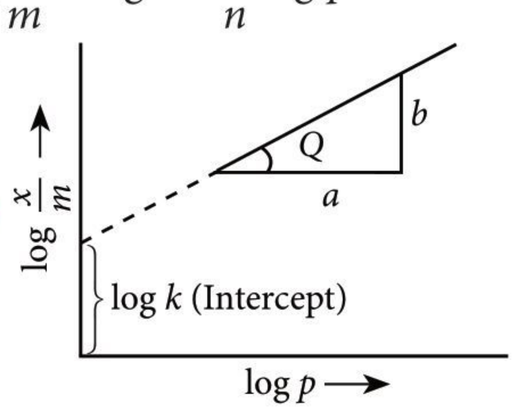
11. **(i)** From Freundlich adsorption isotherm

$$\frac{x}{m} = k \cdot p^{1/n}\ (n > 1)$$

Taking log on both sides, we have

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log p \qquad \ldots(1)$$

(ii)



Using $y = mx + c$, on comparing with eq. (1), we have,

$$\text{slope } (m) = \frac{1}{n}$$

(iii) Intercept gives the value of log *k*.

12. **(i)** Rate = $k[A]^{1/2}[B]^{3/2}$

Because reaction is an elementary reaction, hence order of reaction will be = $\frac{1}{2} + \frac{3}{2} = 2$

(ii) Rate of reaction increases with increase in temperature.

(iii) Rate of reaction is the rate of change in concentration of a reactant or product in unit time.

(iv) (a) For a first order reaction,

$$t_{1/2} = \frac{0.693}{k} = 77.78\ min\ ;\ k = 8.90 \times 10^{-3}\ min^{-1}$$

Time required for 30% completion,

$$t = \frac{1}{k} \ln \left(\frac{100}{70}\right) = \frac{0.356}{8.90 \times 10^{-3}\ min^{-1}}$$

$t = 0.040 \times 10^3\ min = 40\ min$

OR

(b) Given : For first order reaction, $k = 1 \times 10^{-3}\ sec^{-1}$

$$t = \frac{1}{k} \ln \frac{[A_o]}{[A]}$$

$$t = \frac{1}{1 \times 10^{-3}\ sec^{-1}} \ln \left(\frac{5}{3}\right) = \frac{0.5108}{1 \times 10^{-3}\ sec^{-1}} = 510.8\ sec$$

CBSE warm-up! CLASS-XII

Chapterwise practice questions for CBSE Exams as per the latest pattern and reduced syllabus by CBSE for the academic session 2022-23.

Series-1

Solutions

Time Allowed : 3 hours
Maximum Marks : 70

GENERAL INSTRUCTIONS

General Instructions : Read the following instructions carefully.

(a) There are 33 questions in this question paper. All questions are compulsory.
(b) Section A : Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
(c) Section B : Q. No. 17 to 25 are short answer questions and carry 2 marks each.
(d) Section C : Q. No. 26 to 30 are short answer questions and carry 3 marks each.
(e) Section D : Q. No. 31 to 33 are long answer questions carrying 5 marks each.
(f) There is no overall choice. However, internal choices have been provided.
(g) Use of calculators and log tables is not permitted.

SECTION - A (OBJECTIVE TYPE)

Read the passage given below and answer the following questions :

1. Boiling point elevation describes the phenomenon that boiling point of a liquid (a solvent) will be higher when another compound is added, which means a solution has higher boiling point than a pure solvent. This happens whenever a non-volatile solute such as salt is added to pure solvent such as water. For example, the addition of 3 g of a substance to 100 g CCl_4 (M = 154 g mol^{-1}) raises the boiling point of CCl_4 by 0.60°C. K_b (CCl_4) is 5.03 K kg mol^{-1}. Given : $K_f(CCl_4)$ = 31.8 K kg mol^{-1} and density (ρ) of solution = 1.64 g cm^{-3}.

The following questions are multiple choice questions. Choose the most appropriate answer.

(i) The molality of solution is
(a) 0.12 mol kg^{-1} (b) 0.21 mol kg^{-1}
(c) 0.01 mol kg^{-1} (d) 2.10 mol kg^{-1}

(ii) The freezing point depression of the solution is
(a) 2.196 K (b) 3.816 K
(c) 3.00 K (d) 4.126 K.

(iii) What will be the molar mass (g mol^{-1}) of substance?
(a) 350 (b) 150 (c) 300 (d) 250

(iv) For the given solution, the relative lowering of vapour pressure is
(a) 0.01814 (b) 0.02210
(c) 1.0210 (d) 1.512

OR

At 298 K, the osmotic pressure of solution is
(a) 4.002 atm (b) 4.669 atm
(c) 5.105 atm (d) 3.253 atm.

Read the passage given below and answer the following questions :

2. When the molecular mass of a substance determined by any of the colligative properties comes out to be different than the expected value, the substance is said to show abnormal molecular mass.

Abnormal molecular masses are observed when the solution is non-ideal (not dilute) or the solute undergoes *association* or *dissociation*.

In these questions (Q. No. (i)-(iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** 1 M solution of KCl has greater osmotic pressure than 1 M solution of glucose at same temperature.
Reason : In solution, KCl dissociates to produce more number of particles.

(ii) **Assertion :** KCl in water and benzoic acid in benzene show abnormal molecular mass.
Reason : Abnormal molecular mass is obtained when the substance in the solution undergoes dissociation or association.

OR

Assertion : 0.1 m glucose solution has higher depression in the freezing point than 0.1 m urea solution.
Reason : Both are non-electrolytes.

(iii) **Assertion :** The boiling point of 0.1 M urea solution is less than that of 0.1 M KCl solution.
Reason : Elevation of boiling point is directly proportional to the number of species present in the solution.

(iv) **Assertion :** The molecular weight of acetic acid determined by depression in freezing point method in benzene and water was found to be different.
Reason : Water is polar and benzene is non polar.

Following questions (Q. No. 3-11) are multiple choice questions carrying 1 mark each :

3. The concentration in g/L of a solution of cane sugar (m = 342 g) which is isotonic with a solution containing 6 g of urea (m = 60 g) per litre is
(a) 3.42 (b) 34.2 (c) 5.7 (d) 19.

4. Arrange the following aqueous solutions in the order of their increasing boiling points.
(i) 10^{-4} M NaCl (ii) 10^{-4} M Urea
(iii) 10^{-3} M $MgCl_2$ (iv) 10^{-2} M NaCl
(a) (i) < (ii) < (iv) < (iii) (b) (ii) < (i) = (iii) < (iv)
(c) (ii) < (i) < (iii) < (iv) (d) (iv) < (iii) < (i) = (ii).

OR

A 0.5 molal solution of ethylene glycol in water is used as coolant in a car. If K_f for water is 1.86 K kg mol^{-1} the mixture shall freeze at
(a) 0.93 °C (b) –0.93 °C
(c) 1.86 °C (d) –1.86 °C

5. The boiling point of a solution of 0.11 g of a substance in 15 g of ether was found to be 0.1°C higher than that of pure ether. The molecular weight of the substance will be (K_b = 2.16 K kg mol^{-1})
(a) 148 (b) 158 (c) 168 (d) 178.

6. What are the conditions for an ideal solution which obeys Raoult's law over the entire range of concentration?
(a) $\Delta_{mix}H = 0, \Delta_{mix}V = 0, P_{Total} = p^\circ_A x_A + p^\circ_B x_B$
(b) $\Delta_{mix}H$ = +ve, $\Delta_{mix}V = 0, P_{Total} = p^\circ_A x_A + p^\circ_B x_B$
(c) $\Delta_{mix}H = 0, \Delta_{mix}V$ = +ve, $P_{Total} = p^\circ_A x_A + p^\circ_B x_B$
(d) $\Delta_{mix}H = 0, \Delta_{mix}V = 0, P_{Total} = p^\circ_B x_B$

7. The vapour pressure of a solvent decreased by 10 mm of Hg when a non-volatile solute was added to the solvent. The mole fraction of solute in solution is 0.2, What would be the mole fraction of solvent if decrease in vapour pressure is 20 mm of Hg ?
(a) 0.8 (b) 0.6 (c) 0.4 (d) 0.2.

OR

A solution containing 0.5216 g of naphthalene (molecular weight = 128.16) in 50 mL of CCl_4 shows boiling point elevation of 0.402 °C. While a solution of 0.6216 g of an unknown solute in the same weight of solvent gave a boiling point elevation of 0.647 °C. The molecular mass of unknown solute is
(a) 94.9 (b) 173 (c) 159.5 (d) 197.8.

8. The normal boiling point of water is 373 K (at 760 mm of Hg). Vapour pressure of water at 298 K is 23 mm of Hg. If enthalpy of vaporisation is 40.656 kJ/ mol, the boiling point of water at 23 mm of Hg atmospheric pressure will be
(a) 250 K (b) 51.6 K (c) 298 K (d) 12.5 K.

9. An aqueous solution containing 1g of urea boils at 100.25°C. The aqueous solution containing 3 g of glucose in the same volume will boil at
(a) 100.75°C (b) 100.5°C
(c) 100°C (d) 100.25°C.

OR

When a sugar solution is slowly frozen, the first solid which separates out is

(a) ice
(b) solid solution of sugar and ice
(c) sugar
(d) a compound formed from sugar and water.

10. Osmotic pressure of urea solution at 10 °C is 500 mm of Hg. The solution is diluted with temperature raised to 25 °C till its osmotic pressure becomes 131.6 mm of Hg. The solution is diluted

(a) 3 times (b) 3.5 times
(c) 4 times (d) 3.8 times.

11. A 0.6 % solution of urea (molecular weight = 60) would be isotonic with

(a) 0.1 M glucose (b) 0.1 M KCl
(c) 0.6 % glucose solution
(d) 0.6 % KCl solution.

OR

A dilute aqueous solution of glucose shows a vapour pressure of 750 mm of Hg at 373 K. The molality of the solution is

(a) 13.32 (b) 0.013 (c) 1.35 (d) 0.74.

In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

12. **Assertion :** Elevation of boiling point increases with increase in number of moles of solute.
Reason : The impurities in water bring down its boiling point.

13. **Assertion :** The sum of mole fractions of all the components of a solution is unity.
Reason : Mole fraction is temperature dependent mode of concentration.

14. **Assertion :** Isotonic solutions must have the same molar concentrations.
Reason : Solutions which have the same osmotic pressure at the same temperature are known as isotonic solutions.

OR

Assertion : An increase in surface area increases the rate of evaporation.
Reason : Stronger the inter-molecular attractive forces, faster is the rate of evaporation at a given temperature.

15. **Assertion :** Boiling point elevation is a colligative property.
Reason : Boiling point elevation in a dilute solution is directly proportional to the molality of the solute in a given solvent and is independent of the nature of the solute.

16. **Assertion :** Osmosis involves movement of solvent molecules from lower concentration to higher concentration.
Reason : Solutions having the same osmotic pressure are called isotonic solutions.

SECTION - B

The following questions, Q. No. 17-25 are short answer type and carry 2 marks each.

17. 15.0 g of a material was dissolved in 450 g of water. The resulting solution was found to freeze at –0.34°C. What is the molar mass of this material? (K_f for water = 1.86 K kg mol^{-1})

OR

An electrolyte *AB* is 50% ionised in aqueous solution. Calculate the freezing point of 1 molal aqueous solution. (K_f for water = 1.86 K kg mol^{-1})

18. Calculate the mass of urea (NH_2CONH_2) required to make 2.5 kg of 0.25 molal aqueous solution.

19. Blood cells are isotonic with 0.9% sodium chloride solution. What happens if we place blood cells in a solution containing

(i) 1.2% sodium chloride solution?
(ii) 0.4% sodium chloride solution?

OR

Calculate the molarity of 9.8% (*w*/*W*) solution of H_2SO_4 if the density of the solution is 1.02 g mL^{-1}. (Molar mass of H_2SO_4 = 98 g mol^{-1})

20. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C. Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = 0.512 K kg mol^{-1})

21. 4% NaOH solution (mass/volume) and 6% urea solution (mass/volume) are equimolar but not isotonic. Why?

22. An aqueous solution of sodium chloride freezes below 273 K. Explain the lowering in freezing point of water with the help of a suitable diagram.

23. Calculate the boiling point of a solution prepared by adding 15.00 g of NaCl to 250.00 g of water. (K_b for water = 0.512 K kg mol^{-1}, $i = 2$. Molar mass of NaCl = 58.44 g)

24. State Henry's law and mention two of its important applications.

OR

State Raoult's law for the solution containing volatile components. What is the similarity between Raoult's law and Henry's law?

25. What type of azeotropic mixture will be formed by a solution of acetone and chloroform? Justify on the basis of strength of intermolecular interactions that develop in the solution.

SECTION - C

Q. No. 26-30 are short answer type II carrying 3 marks each.

26. Phenol associates in benzene to a certain extent to form a dimer. A solution containing 20 g of phenol in 1.0 kg of benzene has its freezing point lowered by 0.69 K. Calculate the fraction of phenol that has dimerised.
[Given : K_f for benzene = 5.1 K kg mol^{-1}]

27. **(i)** What is osmotic pressure and how is it related with the molecular mass of the non-volatile solution?

(ii) Write two advantages of osmotic pressure method over boiling point elevation method for determining molecular masses.

OR

(a) Define reverse osmosis.

(b) What happens when a peeled egg is placed in a 10% aqueous solution of NaCl?

(c) Why do mechanics suggest to add coolant in car radiators instead of pure water?

28. The vapour pressure of pure liquids *A* and *B* are 450 and 700 of mm of Hg respectively, at 350 K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm of Hg. Also find the composition of the vapour phase.

29. **(i)** Calculate the boiling point elevation for a solution prepared by adding 10 g of $CaCl_2$ to 200 g of water. (K_b for water = 0.52 K kg mol^{-1}, molar mass of $CaCl_2$ = 111 g mol^{-1})

(ii) How is the vapour pressure of a solvent affected when a non-volatile solute is dissolved in it?

OR

A solution containing 30 g of non-volatile solute exactly in 90 g of water has a vapour pressure of 2.8 kPa at 298 K. Further 18 g of water is added to this solution. The new vapour pressure becomes 2.9 kPa at 298 K. Calculate

(i) the molecular mass of solute and

(ii) vapour pressure of water at 298 K.

30. **(i)** Determine the osmotic pressure of a solution prepared by dissolving 2.5×10^{-2} g of K_2SO_4 in 2 L of water at 25 °C, assuming that it is completely dissociated.
(R = 0.0821 L atm K^{-1} mol^{-1}, molar mass of K_2SO_4 = 174 g mol^{-1})

(ii) Gas (*A*) is more soluble in water than gas (*B*) at the same temperature. Which one of the two gases will have the higher value of K_H (Henry's constant) and why?

SECTION - D

Q No. 31-33 are long answer type carrying 5 marks each.

31. **(a)** Some ethylene glycol, $HOCH_2CH_2OH$, is added to your car's cooling system along with 5 kg of water. If the freezing point of water-glycol solution is –15.0°C, what is the boiling point of the solution?
(K_b = 0.52 K kg mol^{-1} and K_f = 1.86 K kg mol^{-1} for water)

(b) Give reason for the following :
Elevation of boiling point of 1 m KCl solution is nearly double than that of 1 m sugar solution.

(c) Why aquatic animals are more comfortable in cold water than in warm water?

OR

(a) A 5% solution (by mass) of cane-sugar in water has freezing point of 271 K. Calculate the freezing point of 5% solution (by mass) of glucose in water if the freezing point of pure water is 273.15 K.
[Molecular masses : Glucose $C_6H_{12}O_6$: 180 g; Cane-sugar $C_{12}H_{22}O_{11}$: 342 g]

(b) A solution of glucose ($C_6H_{12}O_6$) in water is labelled as 10% by weight. What would be the molality of the solution?
(Molar mass of glucose = 180 g mol^{-1})

32. (a) What mass of NaCl must be dissolved in 65.0 g of water to lower the freezing point of water by 7.50 °C? The freezing point depression constant (K_f) for water is 1.86 °C/m. Assume van't Hoff factor for NaCl is 1.87.
(Molar mass of NaCl = 58.5 g mol^{-1})

(b) An aqueous solution containing 12.48 g of barium chloride in 1.0 kg of water boils at 373.0832 K. Calculate the degree of dissociation of barium chloride.
[Given K_b for H_2O = 0.52 K kg mol^{-1};
Molar mass of $BaCl_2$ = 208.34 g mol^{-1}]

OR

(a) Calculate the freezing point of an aqueous solution containing 10.50 g of $MgBr_2$ in 200 g of water. (Molar mass of $MgBr_2$ = 184 g mol^{-1}, K_f for water = 1.86 K kg mol^{-1})

(b) 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the van't Hoff factor and predict the nature of solute (associated or dissociated).
(Given : Molar mass of benzoic acid = 122 g mol^{-1}, K_f for benzene = 4.9 K kg mol^{-1})

33. (a) Differentiate between molarity and molality in a solution. What is the effect of temperature change on molarity and molality in a solution?

(b) The partial pressure of ethane over a saturated solution containing 6.56×10^{-2} g of ethane is 1 bar. If the solution contains 5.0×10^{-2} g of ethane, then what will be the partial pressure of the gas?

OR

(a) Define azeotropes. What type of azeotrope is formed by negative deviation from Raoult's law? Give an example.

(b) (i) Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why?
(ii) What happens when the external pressure applied becomes more than the osmotic pressure of solution?

(c) Give reason for the following :
Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers.

SOLUTIONS

1. (i) (a) : The molality of the given solution is

$$m = \frac{\Delta T_b}{K_b} = \frac{0.60}{5.03} = 0.12 \text{ mol kg}^{-1}$$

(ii) (b) : $\Delta T_f = K_f m = 31.8 \times 0.12 = 3.816$ K

(iii) (d) : From the molality of the solution, we get

$$\text{Molality} = \frac{n_2 \times 1000}{m_1} = \frac{m_2/M_2 \times 1000}{m_1}$$

$$\text{or} \quad 0.12 = \frac{3/M_2 \times 1000}{100}; \; M_2 = 250 \text{ g}$$

(iv) (a) : $\frac{p^\circ - p_s}{p^\circ} = x_2 = \frac{n_2}{n_1 + n_2}$

$$\frac{p^\circ - p_s}{p^\circ} = \frac{3/M_2}{100/154 + 3/M_2}$$

$$\frac{p^\circ - p_s}{p^\circ} = \frac{3/250}{100/154 + 3/250} = 0.01814$$

OR

(b) : $\pi = CRT = \frac{n_2}{V}RT; \; n_2 = \frac{m_2}{M_2} = \frac{3}{250} = 0.012$

$$V = \frac{\text{mass of solution}}{\text{density of solution}} = \frac{100+3}{1.64} = 62.8 \text{ cm}^3$$

$= 0.0628 \text{ dm}^3$

$$\text{Hence, } \pi = \frac{0.012 \times 0.082 \times 298}{0.0628} = 4.669 \text{ atm}$$

2. (i) (a) **(ii) (a)** **OR** **(d)**
(iii) (a) **(iv) (b)**

3. (b) : The two solutions should have same molar concentration for being isotonic.
Molar concentration of cane sugar

$$= \text{Molar concentration of urea} = \frac{6}{60} = 0.1 \text{ mol/L}$$

Concentration of cane sugar in g/L
= Molar concentration × Molecular weight
= 0.1 × 342 = 34.2 g/L

4. (c)

OR

(b) : $\Delta T_f = K_f.m = 1.86 \times 0.5 = 0.93$
$T_f = T_0 - \Delta T_f = 0 - 0.93 = -0.93°C$
(Freezing point of water = 0°C)

5. (b) : $M_2 = \frac{K_b \times w_2 \times 1000}{\Delta T_b \times w_1}$

$$= \frac{2.16 \times 0.11 \times 1000}{0.1 \times 15} \approx 158 \text{ g}$$

6. (a)

7. (b) : $\frac{\Delta p}{p_0} = X_{\text{solute}}$ or $p_0 = \frac{\Delta p}{X_{\text{solute}}}$

when Δp = 10 mm of Hg $p_0 = \frac{10}{0.2}$

Δp = 20 mm of Hg, $p_0 = \frac{20}{X_{\text{solute}}}$ $\therefore$ $\frac{10}{0.2} = \frac{20}{X_{\text{solute}}}$

$X_{\text{solute}} = \frac{20 \times 0.2}{10} = 0.4$; $X_{\text{solvent}} = 1 - 0.4 = 0.6$

OR

(a) : We know, $M_2 = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$

For naphthalene, $128.16 = \frac{K_b \times 0.5216 \times 1000}{0.402 \times W_1}$ ....(i)

For unknown solute, $M_2 = \frac{K_b \times 0.6216 \times 1000}{0.647 \times W_1}$ ....(ii)

(K_b is constant in two cases since the solvent is same)

dividing (ii) by (i), $\frac{M_2}{128.16} = \frac{0.6216}{0.647} \times \frac{0.402}{0.5216}$

$M_2 = 94.89 \approx 94.9$ g

8. (c)

9. (d) : Number of moles of urea = $\frac{1}{60}$

Number of moles of glucose = $\frac{3}{180} = \frac{1}{60}$

Since, the molar concentration of the two solutions is same (amount of solvent given is same), the two solutions boil at the same temperature.

OR

(a) : First, ice will separate out. The solution has lower freezing point.

10. (c) : $\pi = \frac{n}{V}RT$

Before dilution $\frac{500}{760} = \frac{n}{V_1} \times 0.0821 \times 283$ ...(i)

after dilution $\frac{131.6}{760} = \frac{n}{V_2} \times 0.0821 \times 298$ ...(ii)

Dividing (i) by (ii), $\frac{V_2}{V_1} = \frac{500}{131.6} \times \frac{298}{283} = 4$

$\therefore$ $V_2 = 4V_1$

11. (a) : Two solvents will be isotonic if both are of same concentration with equal value of i.

0.6% solvent of urea means 0.6 g of urea dissolved in 100 g of water.

Molar concentration $(M) = \frac{0.6}{60} \times \frac{1000}{100} = 0.1$ M

(density of water = 1 g/mL; $\therefore$ 100 g = 100 mL)

For urea, i = 1

Thus, it would be isotonic with 0.1 M glucose for which i = 1.

OR

(d) : $\frac{p^\circ - p_s}{p^\circ} = X_2$ (Raoult's law)

$\frac{760 - 750}{760} = X_2 = 0.0132$

mole fraction of solvent (X_1) = 1 – 0.0132 = 0.9868

it means 0.0132 mole of glucose is present per 0.9868 mole of water.

Weight of solvent = 0.9868 × 18 = 17.76 g

(molecular weight of H_2O = 18)

molality = $\frac{0.0132 \times 1000}{17.76} = 0.74$ m

12. (c) **13. (c)** **14. (a)**

OR

(c) : The rate of evaporation depends upon the nature of the liquid or magnitude of the inter-molecular attractive forces. Weaker the inter-molecular attractive forces, faster is the rate of evaporation at a given temperature.

15. (a) **16. (b)**

17. W_1 = 450 g, W_2 = 15.0 g

ΔT_f = 0.34 K

K_f = 1.86 K kg mol^{-1}

$\Delta T_f = \frac{K_f \times W_2 \times 1000}{M_2 \times W_1} \Rightarrow M_2 = \frac{K_f \times W_2 \times 1000}{\Delta T_f \times W_1}$

$M_2 = \frac{1.86 \times 15 \times 1000}{0.34 \times 450} = 182.35$ g mol^{-1}

OR

$\alpha = 0.5, n = 2, \alpha = \frac{i-1}{n-1} \Rightarrow 0.5 = \frac{i-1}{2-1} \Rightarrow i = 1.5$

$\Delta T_f = i \times K_f \times m = 1.5 \times 1.86 \times 1 = 2.79$ K

Freezing point of solution = 273 – 2.79 = 270.21 K

Quotable Quote

"Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world."

Louis Pasteur

18. Molality = 0.25 mol kg^{-1}
1 kg of solvent has urea = 0.25 mol
Thus, 2.5 kg of solvent has urea = 2.5 × 0.25
= 0.625 mol = 0.625 × 60 = 37.5 g

19. (i) 1.2% sodium chloride solution is hypertonic with respect to 0.9% sodium chloride solution or blood cells thus, on placing blood cells in this solution exosmosis takes place that results in shrinking of cells.
(ii) 0.4% sodium chloride solution is hypotonic with respect to 0.9% sodium chloride solution or blood cells thus, on placing blood cells in this solution endosmosis takes place that results in swelling of cells.

OR

Mass of solute = 9.8 g. Mass of solution = 100 g
Density of solution = 1.02 g mL^{-1}

$$\therefore \quad \text{Volume of solution} = \frac{\text{Mass of solution}}{\text{Density of solution}}$$

$$= \frac{100\text{ g}}{1.02\text{ g mL}^{-1}} = 98.039\text{ mL} = 0.098\text{ L}$$

$$\text{Number of moles of solute, } n = \frac{9.8}{98} = 0.1\text{ mol}$$

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}}$$

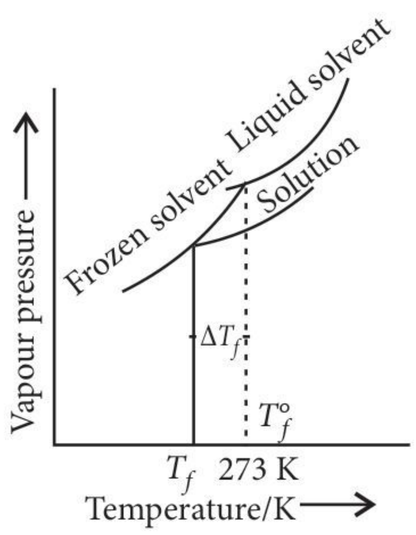
$$= \frac{0.1\text{ mol}}{0.098\text{ L}} = 1.02\text{ M}$$

20. Molality of solution, m = 1.00 m
Boiling point of solution, $T_b = 100.18°C = 373.18$ K
Boiling point of water (solvent), $T_b^\circ = 100.00°C = 373$ K
$\Delta T_b = T_b - T_b^\circ = 373{\cdot}18\text{ K} - 373\text{ K} = 0{\cdot}18\text{ K}$; $\Delta T_b = i\,K_b{\cdot}m$
$0.18\text{ K} = i \times K_b{\cdot}m$
$0.18\text{ K} = i \times 0.512\text{ K kg mol}^{-1} \times 1\text{ mol kg}^{-1}$

$$i = \frac{0.18\text{ K}}{0.512\text{ K kg mol}^{-1} \times 1\text{ mol kg}^{-1}} = 0.35$$

21. Both the solutions 4% NaOH (w/V) and 6% urea (w/V) have same concentration (1 M) but these are not isotonic because NaOH undergoes dissociation in solution but urea does not. Therefore, number of particles in NaOH solution is more than that in urea solution.

22. When a non-volatile solute is added to a solvent, the freezing point of the solution is always lower than that of pure solvent as the vapour pressure of the solvent decreases in the presence of non-volatile solute. Plot for the lowering in freezing point of water when NaCl is added to it is shown as :



23. $i = 2$, $K_b = 0.512$ K kg mol^{-1}, $W_B = 15$ g
$M_B = 58.44$ g mol^{-1}, $W_A = 250$ g

$$\Delta T_b = \frac{i \times K_b \times W_B \times 1000}{M_B \times W_A}$$

$$\Delta T_b = \frac{2 \times 0.512 \times 15 \times 1000}{58.44 \times 250} = 1.05\text{ K}$$

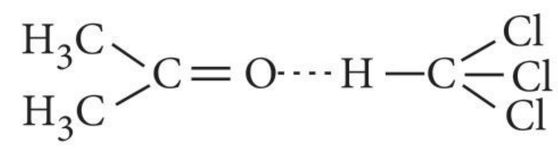
Therefore, boiling point of aqueous solution,
$T_b = T_b^\circ + \Delta T_b = 373.15\text{ K} + 1.05\text{ K} = 374.20\text{ K}$

24. Henry's law states that, the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution.
$p = K_H{\cdot}x$ where, K_H = Henry's law constant. Different gases have different K_H values at the same temperature.
Applications of Henry's law :
(i) To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.
(ii) To minimise the painful effects of decompression sickness in deep sea divers, oxygen diluted with less soluble helium gas is used as breathing gas.

OR

Raoult's law : For a solution of volatile liquids, the partial pressure of each component in the solution is directly proportional to its mole fraction. Thus, for any component, partial vapour pressure, $p \propto x \Rightarrow p = p^\circ . x$
where, p° = vapour pressure of pure component
x = mole fraction of that component
Henry's law : If gas is the solute and liquid is the solvent, then according to Henry's law,
$p = K_H{\cdot}x$
i.e., partial pressure of the volatile component (gas) is directly proportional to the mole fraction of that component (gas) in the solution.
Hence, Raoult's law and Henry's law has been identical except that their proportionality constant are different. It is equal to p° for Raoult's law and K_H for Henry's law. Therefore, Raoult's law becomes a special case of Henry's law in which K_H becomes equal to vapour pressure of pure component p°.

25. Mixture of chloroform and acetone shows negative deviation from Raoult's law, thus it forms maximum boiling azeotrope. This is because chloroform molecule is able to form hydrogen bond with acetone molecule as shown :



This decreases the escaping tendency of molecules for each component and consequently the vapour pressure decreases resulting in negative deviation from Raoult's law.

26. (a) : Here, $n = 2$ because phenol forms dimer on association.

$W_2 = 20$ g, $W_1 = 1$ kg $= 1000$ g, $\Delta T_f = 0.69$ K,

$K_f = 5.1\ \text{K m}^{-1}$; $\Delta T_f = \dfrac{K_f \times W_2 \times 1000}{M_2 \times W_1}$

$$M_2 = \frac{K_f \times W_2 \times 1000}{\Delta T_f \times W_1} = \frac{5.1 \times 20 \times 1000}{0.69 \times 1000} = 147.82\ \text{g/mol}$$

$M_{2(\text{observed})} = 147.82\ \text{g mol}^{-1}$

$M_{2(\text{calculated})}$ for $C_6H_5OH = 6 \times 12 + 6 \times 1 + 16$

$= 94\ \text{g mol}^{-1}$

$$i = \frac{M_{2(\text{calculated})}}{M_{2(\text{observed})}} = \frac{94}{147.82} = 0.635$$

$2C_6H_5OH \rightleftharpoons (C_6H_5OH)_2$

$$\alpha = \frac{i-1}{\left(\frac{1}{n}-1\right)} = \frac{0.635-1}{\left(\frac{1}{2}-1\right)} = \frac{0.365}{0.5} = 0.73 = 73\%$$

27. (i) The flow of the solvent from its side to solution side across a semi permeable membrane can be stopped if some extra pressure is applied on solution. This pressure which just stops the flow of solvent is called osmotic pressure.

Relation between osmotic pressure and molecular masses of solute, $\pi V = \dfrac{w}{M}RT$ or $\pi = \dfrac{wRT}{MV}$

where, π = Osmotic pressure

M = Molar mass of solute

(ii) (a) Osmotic pressure method gives large value for even small amount of solute.

(b) This experiment is performed at normal temperature, hence no heating or cooling is required.

OR

(a) Reverse osmosis : It is the movement of solvent particles from higher concentration of a solution to lower concentration of the solution through a semi-permeable membrane.

(b) Peeled egg will start shrinking due to exosmosis of water present in the egg that will come out through its membrane.

(c) Coolant (ethylene glycol) needs to be added in car radiators to run the vehicles at higher temperature by elevation of boiling point and in case of hill stations by depression in freezing point that prevents water from freezing.

28. Given : $p^\circ_A = 450$ mm of Hg, $p^\circ_B = 700$ mm of Hg, $P_{\text{Total}} = 600$ mm of Hg, $x_A = ?$

Applying Raoult's law, $p_A = x_A \times p^\circ{}_A$

$p_B = x_B \times p^\circ{}_B = (1 - x_A)p^\circ{}_B$

$P_{\text{Total}} = p_A + p_B = x_A \times p^\circ{}_A + (1 - x_A)p^\circ{}_B$

$= p^\circ{}_B + (p^\circ{}_A - p^\circ{}_B)x_A$

Substituting the given values, we get

$600 = 700 + (450 - 700)x_A$ or, $250x_A = 100$

or $x_A = \dfrac{100}{250} = 0.40$

Thus, composition of the liquid mixture will be

$x_A = 0.40$; $x_B = 1 - 0.40 = 0.60$

Calculation of composition in the vapour phase,

$p_A = x_A \times p^\circ{}_A = 0.40 \times 450$ mm of Hg $= 180$ mm of Hg

$p_B = x_B \times p^\circ{}_B = 0.60 \times 700$ mm of Hg $= 420$ mm of Hg

Mole fraction of A in the vapour phase

$$= \frac{p_A}{p_A + p_B} = \frac{180}{180 + 420} = 0.30$$

Mole fraction of B in the vapour phase $= 1 - 0.30 = 0.70$

29. (i) Mass of $CaCl_2$ (W_2) $= 10$ g

Mass of water (W_1) $= 200$ g

Molar mass of $CaCl_2$ (M_2) $= 111\ \text{g mol}^{-1}$

Molal elevation constant (K_b) $= 0.52\ \text{K kg mol}^{-1}$

$$m = \frac{W_2 \times 1000}{M_2 \times W_1}\ ;\ m = \frac{10}{111} \times \frac{1000}{200} = 0.450\ \text{m}$$

$\Delta T_b = iK_b\, m = 3 \times 0.52 \times 0.450 = 0.702$ K

(ii) When a non-volatile solute is added to a solvent, the vapour pressure of the solvent (above the resulting solution) is lower than the vapour pressure above the pure solvent.

OR

The relative lowering of vapour pressure is given by the following expression,

$(p^\circ_{\text{solvent}} - p_{\text{solution}})/p^\circ_{\text{solvent}} = n_2/(n_1 + n_2)$

for dilute solutions, $n_2 << n_1$, therefore

$(p^\circ_{\text{solvent}} - p_{\text{solution}})/p^\circ_{\text{solvent}} = n_2/n_1$

$= (W_2 \times M_1)/(M_2 \times W_1)$

$(p^\circ_{\text{solvent}} - 2.8)/p^\circ_{\text{solvent}} = (30 \times 18)/(M_2 \times 90)$

$(p^\circ_{\text{solvent}} - 2.8)/p^\circ_{\text{solvent}} = 6/M_2$ ...(1)

Similarly for second case we get,

$(p^\circ_{\text{solvent}} - 2.9)/p^\circ_{\text{solvent}} = (30 \times 18)/(M_2 \times 108)$

$(p^\circ_{\text{solvent}} - 2.9)/p^\circ_{\text{solvent}} = 5/M_2$ ...(2)

Dividing eq. (1) by (2), we get

$(p^\circ_{\text{solvent}} - 2.8)/(p^\circ_{\text{solvent}} - 2.9) = 6/5$

$\therefore\ p^\circ_{\text{solvent}} = 3.4$ kPa

i.e., vapour pressure of water at 298 K is 3.4 kPa

Substituting the value of p°_{solvent} in (1) we get,

$(3.4 - 2.8)/3.4 = 6/M_2$ or $0.6/3.4 = 6/M_2$

$\therefore\ M_2 = 34\ \text{g mol}^{-1}$

30. (i) Mass of K_2SO_4, $W_2 = 2.5 \times 10^{-2}$ g

Molar mass of K_2SO_4, $M_2 = 174\ \text{g mol}^{-1}$

$V = 2$ L, $T = 25°C = 298$ K

$R = 0.0821\ \text{L atm K}^{-1}\ \text{mol}^{-1}$

$i = 3$

We know, osmotic pressure, $\pi = \frac{iW_2RT}{M_2V}$

$$\pi = \frac{3 \times 2.5 \times 10^{-2} \times 0.0821 \times 298}{174 \times 2}$$

$$= \frac{183.49 \times 10^{-2}}{348} = 0.527 \times 10^{-2} \text{ atm}$$

(ii) According to Henry's law, the solubility of a gas is inversely proportional to the Henry's law constant (K_H) for that gas. Hence, gas (B) being less soluble, would have a higher K_H value.

31. (a) $T_f = -15°C$, $K_f = 1.86$ K kg mol^{-1}

$\Delta T_f = T_f^\circ - T_f = 0 - (-15°C) = 15°C$; $\Delta T_f = K_f \times m$

$15 = 1.86 \times m$; $m = 8.06$

$\Delta T_b = K_b \times m$; $\Delta T_b = 0.52 \times 8.06$

$\Delta T_b = 4.19$ K ; $\Delta T_b = T_b - T°_b$

$4.19 = T_b - 373$; $T_b = 373 + 4.19 = 377.19$ K

(b) i for KCl = 2

i for sugar solution = 1

$\therefore \Delta T_b = iK_b m = 2\ K_b$ (for KCl)

$\Delta T_b = K_b$ (for sugar)

$\therefore$ ΔT_b of 1 m KCl solution is nearly double than that of 1 m sugar solution.

(c) Increase in temperature decreases the solubility of oxygen in water. As a result, amount of dissolved oxygen decreases. It becomes more difficult to breathe as oxygen is less. O_2 is more soluble in cold water, because temperature is low. Hence, the aquatic species are more comfortable in cold water.

OR

(a) Molality of sugar solution

$$= \frac{W_2 \times 1000}{M_2 \times W_1} = \frac{5}{342} \times \frac{1000}{95} = 0.154 \text{ m}$$

$\Delta T_f = T_f^\circ - T_f = 273.15 - 271 = 2.15$ K

$\Delta T_f = K_f \times m \quad \therefore \ K_f = \frac{\Delta T_f}{m} = \frac{2.15}{0.154}$

Molality of glucose solution

$$= \frac{W_2 \times 1000}{M_2 \times W_1} = \frac{5}{180} \times \frac{1000}{95} = 0.292 \text{ m}$$

$\therefore \quad \Delta T_f (\text{Glucose}) = K_f \times m = \frac{2.15}{0.154} \times 0.292 = 4.08$

$\therefore$ Freezing point of glucose solution

$= 273.15 - 4.08 = 269.07$ K

(b) Mass of solution = 100 g

Mass of solute = 10 g

Scientist In Focus

Robert Boyle

Early Life and Education

Robert Boyle
(25 January 1627 - 31 December 1691)

- Boyle was born at Lismore Castle, in County Waterford, Ireland, he was the seventh son and fourteenth child of The 1st Earl of Cork ('the Great Earl of Cork') and Catherine Fenton. As a child, Boyle was raised by a wet nurse, as were his elder brothers. Boyle received private tutoring in Latin, Greek, and French and when he was eight years old, following the death of his mother, he, and his brother Francis, were sent to Eton College in England. After spending over three years at Eton, Robert travelled abroad with a French tutor. Robert returned to England from continental Europe in mid-1644 with a keen interest in scientific research.
- Robert made his residence at Stalbridge House between 1644 and 1652, and settled a laboratory where he conducted many experiments. From that time, Robert devoted his life to scientific research and soon took a prominent place in the band of enquirers, known as the "Invisible College", who devoted themselves to the cultivation of the "new philosophy". They met frequently in London, often at Gresham College, and some of the members also had meetings at Oxford.

Research

- Reading in 1657 of Otto von Guericke's air pump, he set himself, with the assistance of Robert Hooke, to devise improvements in its construction, and with the result, the "machina Boyleana" or "Pneumatical Engine", finished in 1659, he began a series of experiments on the properties of air and coined the term factitious airs. An account of Boyle's work with the air pump was published in 1660 under the title *New Experiments Physico-Mechanical, Touching the Spring of the Air, and its Effects.*
- Boyle made his first mention of the law that the volume of a gas varies inversely to the pressure of the gas, which is called Boyle's Law after his name.
- He made a "wish list" of 24 possible inventions which included "the prolongation of life", the "art of flying", "perpetual light", "making armour light and extremely hard", "a ship to sail with all winds, and a ship not to be sunk", "practicable and certain way of finding longitudes", "potent drugs to alter or exalt imagination, waking memory and other functions and appease pain, procure innocent sleep, harmless dreams, etc.". All but a few of the 24 have come true.

Honours

- As a founder of the Royal Society, he was elected a Fellow of the Royal Society (FRS) in 1663. Boyle's law is named in his honour.
- The Royal Society of Chemistry issues a Robert Boyle Prize for Analytical Science, named in his honour.
- The Boyle Medal for Scientific Excellence in Ireland, inaugurated in 1899, is awarded jointly by the Royal Dublin Society and The Irish Times. Launched in 2012.
- The Robert Boyle Summer School organized by the Waterford Institute of Technology with support from Lismore Castle, is held annually to honour the heritage of Robert Boyle.

Mass of solvent = 100 – 10 = 90 g = 0.09 kg

Number of moles of solute, $n = \frac{10}{180} = 0.055\ \text{mol}$

$$m = \frac{0.055\ \text{mol}}{0.09\ \text{kg}} = 0.61\ \text{m}$$

32. (a) $W_1 = 65.0$ g, $\Delta T_f = 7.50$ °C,
$K_f = 1.86$ °C/m, $i = 1.87$ and $M_2 = 58.5\ \text{g mol}^{-1}$

$$\Delta T_f = \frac{i \times K_f \times W_2 \times 1000}{M_2 \times W_1}$$

$$W_2 = \frac{\Delta T_f \times M_2 \times W_1}{i \times K_f \times 1000} = \frac{7.50 \times 58.5 \times 65}{1.87 \times 1.86 \times 1000} = 8.199\ \text{g}$$

(b) Here, $n = 3$ because 1 molecule of $BaCl_2$ on dissociation gives three ions.
$W_2 = 12.48$ g, $W_1 = 1.0$ kg = 1000 g
$T_b = 373.0832$ K, K_b for $H_2O = 0.52\ \text{K m}^{-1}$
and $M_2(BaCl_2) = 208.34\ \text{g mol}^{-1}$
$\Delta T_b = T_b - T_b^\circ = 373.0832\ \text{K} - 373\ \text{K} = 0.0832\ \text{K}$

$$M_{2(\text{observed})} = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1}$$

$$M_{2(\text{observed})} = \frac{0.52 \times 12.48 \times 1000}{0.0832 \times 1000} = 78$$

$M_{2(\text{observed})} = 78\ \text{g mol}^{-1}$

$$i = \frac{M_{2(\text{calculated})}}{M_{2(\text{observed})}} = \frac{208.34\ \text{g mol}^{-1}}{78\ \text{g mol}^{-1}} = 2.67$$

$$\alpha = \frac{i-1}{n-1} = \frac{2.67-1}{3-1} = \frac{1.67}{2} = 0.835 = 83.5\%$$

OR

(a) $W_2 = 10.50$ g, $W_1 = 200$ g
$M_2(MgBr_2) = 184\ \text{g mol}^{-1}$
$K_f = 1.86\ \text{K kg mol}^{-1}$
$MgBr_{2(aq)} \rightarrow Mg^{2+}_{(aq)} + 2Br^-_{(aq)}$, $i = 3$

$$\Delta T_f = iK_f m, \quad \Delta T_f = \frac{i \times K_f \times W_2 \times 1000}{M_2 \times W_1}$$

$$\Delta T_f = \frac{3 \times 1.86 \times 10.50 \times 1000}{184 \times 200} = 1.592\ \text{K}$$

Freezing point of solution, $T_f = T^\circ_f - \Delta T_f$
$= 273 - 1.592 = 271.408$ K

(b) $W_2 = 3.9$ g, $W_1 = 49$ g,
$\Delta T_f = 1.62$ K, $M_2 = 122\ \text{g mol}^{-1}$, $K_f = 4.9\ \text{K kg mol}^{-1}$

$$\Delta T_f = i\,K_f\,m = i \times K_f \times \frac{W_2 \times 1000}{M_2 \times W_1}$$

$$\Rightarrow \quad 1.62 = \frac{i \times 4.9 \times 3.9 \times 1000}{122 \times 49}$$

$$\Rightarrow \quad i = \frac{1.62 \times 122 \times 49}{4.9 \times 3.9 \times 1000} = 0.506$$

As $i < 1$, solute is associated.

33. (a)

Molarity	Molality
Number of moles of solute dissolved in one litre solution is called molarity.	Number of moles of solute dissolved in one kg solvent is called molality.
$M = \frac{\text{No. of moles of solute}}{\text{Volume of solution (in litre)}}$	$m = \frac{\text{No. of moles of solute}}{\text{Mass of solvent (in kg)}}$
Molarity depends on temperature as volume depends on temperature. Molarity decreases with rise in temperature.	Molality is independent of temperature as mass does not change with temperature.

(b) Applying the relationship, $m = K_H \times p$
In the first case, $6.56 \times 10^{-2}\ \text{g} = K_H \times 1\ \text{bar}$
or, $K_H = 6.56 \times 10^{-2}\ \text{g bar}^{-1}$
In the second case,
$5.0 \times 10^{-2}\ \text{g} = (6.56 \times 10^{-2}\ \text{g bar}^{-1}) \times p$

$$p = \frac{5.0 \times 10^{-2}\ \text{g}}{6.56 \times 10^{-2}\ \text{g bar}^{-1}} = 0.762\ \text{bar}$$

OR

(a) Azeotropes are the binary mixtures of solutions that have the same composition in liquid and vapour phases and that have constant boiling point.
A maximum boiling azeotrope is formed by solutions showing a large negative deviation from Raoult's law at a specific composition.
For example, chloroform + acetone mixture.

(b) (i) The elevation in boiling point of a solution is a colligative property which depends on the number of moles of solute added. Higher the concentration of solute added, higher will be the elevation in boiling point. Thus, 2 M glucose has higher boiling point than 1 M glucose solution.
(ii) When the external pressure applied becomes more than the osmotic pressure of solution then the solvent molecules from the solution pass through the semi-permeable membrane to the solvent side and the process is called reverse osmosis.

(c) In osmotic pressure method, pressure can be measured at room temperature and the molarity of the solution is used instead of molality. That is why this method is used for determination of molar masses of macromolecules as they are generally not stable at higher temperatures.

MONTHLY TEST DRIVE

Practice Paper

This specially designed column enables students to self analyse their extent of understanding the complete syllabus. Give yourself four marks for each correct answer and deduct one mark for each wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120 **Time Taken : 60 Min.**

NEET

Only One Option Correct Type

1. Roasting involves
(a) only volatilisation of volatile impurities
(b) only volatilisation of volatile impurities and decomposition of the ore
(c) volatilisation of volatile impurities, decomposition and oxidation of the ore
(d) oxidation and reduction of the ore and slag formation.

2. The standard reduction potentials (in volts) at 298 K for the following half reactions are given against each:

$Zn^{2+}_{(aq.)} + 2e^- \rightleftharpoons Zn_{(s)}$; −0.762

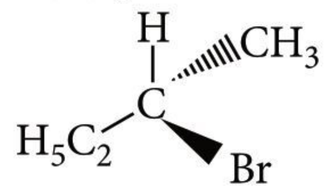
$Cr^{3+}_{(aq.)} + 3e^- \rightleftharpoons Cr_{(s)}$; −0.740

$2H^+_{(aq.)} + 2e^- \rightleftharpoons H_{2(g)}$; 0.00

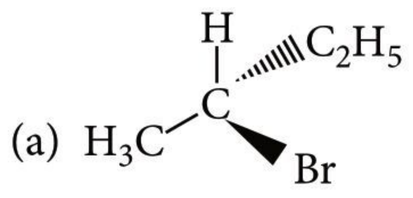
$Fe^{3+}_{(aq.)} + e^- \rightleftharpoons Fe^{2+}_{(aq.)}$; 0.770

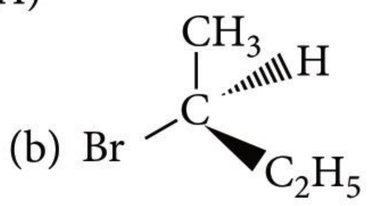
Which is the strongest reducing agent?
(a) $Zn_{(s)}$ (b) $Cr_{(s)}$ (c) $H_{2(g)}$ (d) $Fe^{2+}_{(aq)}$

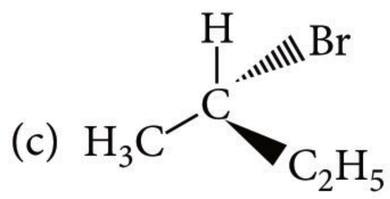
3. Which of the following structures is enantiomeric with the molecule (*A*) given below ?

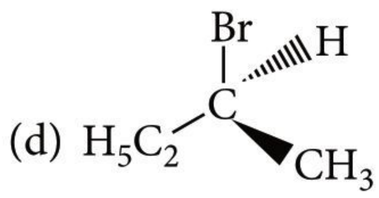


(*A*)

(a) 

(b) 

(c) 

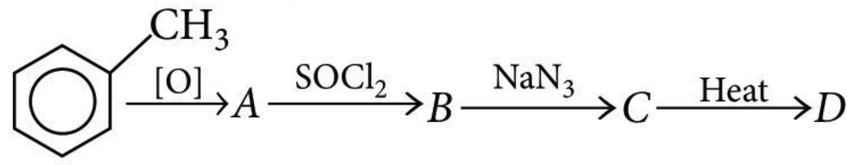
(d) 

4. When 2 g of a non-volatile solute was dissolved in 90 g of benzene the boiling point of benzene is raised by 0.93 K. Which of the following may be the solute? (K_b for benzene = 2.53 K kg mol^{-1})
(a) $CO(NH_2)_2$ (b) $C_6H_{12}O_6$
(c) NaCl (d) None of these.

5. Tailing of mercury is a test for
(a) H_2O_2 (b) O_3
(c) $Na_2S_2O_3 \cdot 5H_2O$ (d) H_2S

6. When KI is added to silver nitrate solution, the Colloidal sol formed may be written as
(a) $AgI \mid I^-$ (b) $AgI \mid Ag^+$
(c) $AgI \mid NO_3^-$ (d) $NO_3^- \mid AgI \mid Ag^+$

7. In the following sequence of reactions, what is D



(a) Primary amine (b) An amide
(c) Phenyl isocyanate
(d) A chain lengthened hydrocarbon

8. In a hexagonal close packed (*hcp*) structure of spheres, the fraction of the volume occupied by the sphere is *A*. In a cubic close packed structure, the fraction is *B*. The relation for *A* and *B* is
(a) $A = B$ (b) $A < B$
(c) $A > B$
(d) $A = B$ = the fraction of a body centred cubic lattice.

9. The number of optical isomers possible for glucose is
(a) 10 (b) 12 (c) 14 (d) 16

10. For the reactions, $A \longrightarrow B$; $k_1 = 10^8 e^{-\frac{6000}{8.314T}}$

and $P \longrightarrow Q$; $k_2 = 10^{10}\, e^{-\frac{8000}{8.314T}}$

The temperature at which $k_1 = k_2$ is

(a) 386 K (b) 221 K (c) 26 K (d) 52 K

11. The commercial name of polyacrylonitrile is_____.

(a) dacron (b) orlon (acrilan)
(c) PVC (d) bakelite

12. Which of the following is not an antibiotic?

(a) Chloramphenicol (b) Sulphadiazine
(c) Penicillin (d) Bithional

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** PCl_5 is covalent in gaseous and liquid states but ionic in solid state.
Reason : PCl_5 in solid state consists of tetrahedral PCl_4^+ cation and octahedral PCl_6^- anion.

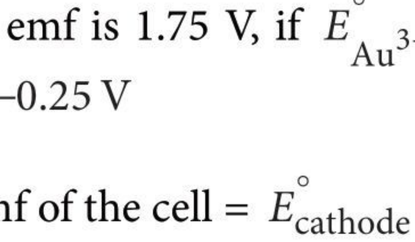
14. **Assertion :** Ni/Ni^{2+} (1.0 M) || Au^{3+} (1.0 M) | Au, for this cell emf is 1.75 V, if $E^\circ_{Au^{3+}/Au} = 1.50$ and $E^\circ_{Ni^{2+}/Ni} = -0.25$ V
Reason : Emf of the cell = $E^\circ_{cathode} - E^\circ_{anode}$.

15. **Assertion :** In strongly acidic solutions, aniline becomes less reactive towards electrophilic reagents.
Reason : The amino group is protonated in strongly acidic solution, and thus the lone pair of electrons on the nitrogen is no longer available for resonance.

JEE MAIN / JEE ADVANCED

Only One Option Correct Type

16. According to structure of H_2SO_5,



which H will be released first as H^+ ?

(a) α
(b) β
(c) both together
(d) above acid is not possible.

17. Identify *X* in the following reaction sequence :

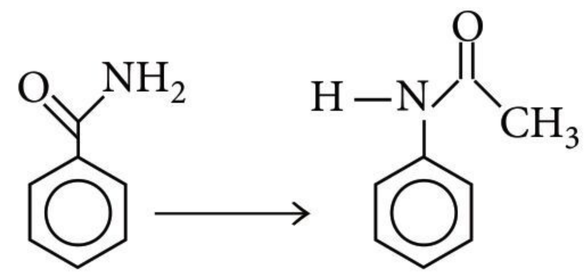
$$X \xrightarrow[H_2SO_4]{K_2Cr_2O_7} C_3H_6O \xrightarrow[I_2+NaOH]{warm} CHI_3$$

(a) $CH_3CH_2CH_2OH$ (b) $CH_3CHOHCH_3$
(c) $CH_3OCH_2CH_3$ (d) CH_3CH_2CHO

18. A coordination complex compound of cobalt has molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three mole ions in an aqueous solution. On reacting this solution with excess of silver nitrate solution, two moles of AgCl get precipitated. The formula of this compound would be

(a) $[Co(NH_3)_4(NO_2)Cl][(NH_3)Cl]$
(b) $[Co(NH_3)_5Cl][Cl(NO_2)]$
(c) $[Co(NH_3)_5(NO_2)]Cl_2$
(d) $[Co(NH_3)_5][(NO_2)Cl_2]$

19. The reagent/s needed for the following conversion is/are



(a) KOH, Br_2; $LiAlH_4$
(b) KOH, Br_2; CH_3COCl
(c) HONO, Cu_2Cl_2; $(CH_3CO)_2O$
(d) KOH, Br_2; Ni, H_2, CH_3COCl

More than One Option Correct Type

20. Which of the following are the properties of solids ?

(a) Solids have high density and low compressibility.
(b) The diffusion of solids is very slow.
(c) Solids have definite volume.
(d) Solids are always crystalline in nature.

21. Which of the following are wrongly matched ?

(a) Galena : $MgCO_3$
(b) Cassiterite : $CaCO_3 \cdot MgCO_3$
(c) Dolomite : SnO_2 (d) Magnesite : $MgCO_3$

22. In which of the following reactions alcohol will be formed as the final product?

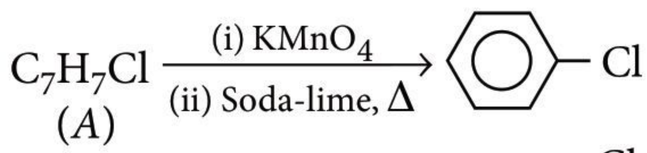
(a) $(CH_3CH_2CH_2-)_3B \xrightarrow{H_2O_2 + NaOH}$

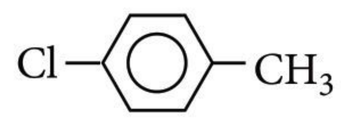
(b) $\left[CH_3 - \underset{\diagdown\ \diagup}{CH} - CH_2\right]^{2+} \underset{Hg}{} (CH_3COO^-)_2 \xrightarrow{H_2O} \xrightarrow{NaBH_4}$

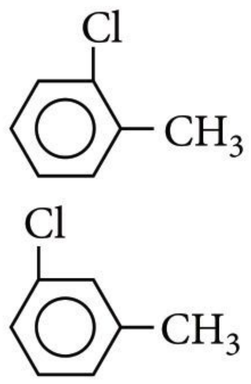
(c) $CH_3 - CH{=}CHMgBr \xrightarrow{O_2,\ \Delta} \xrightarrow{H_2O}$

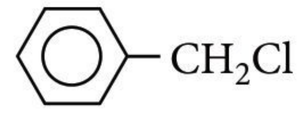
(d) $CH_3 - CH_2 - CH_2MgBr \xrightarrow{\text{O}, THF} \xrightarrow{H_3O^+}$

23. In the given reaction, compound (*A*) is



(a) 

(b) 

(c) 

(d)

Integer / Numerical Value Type

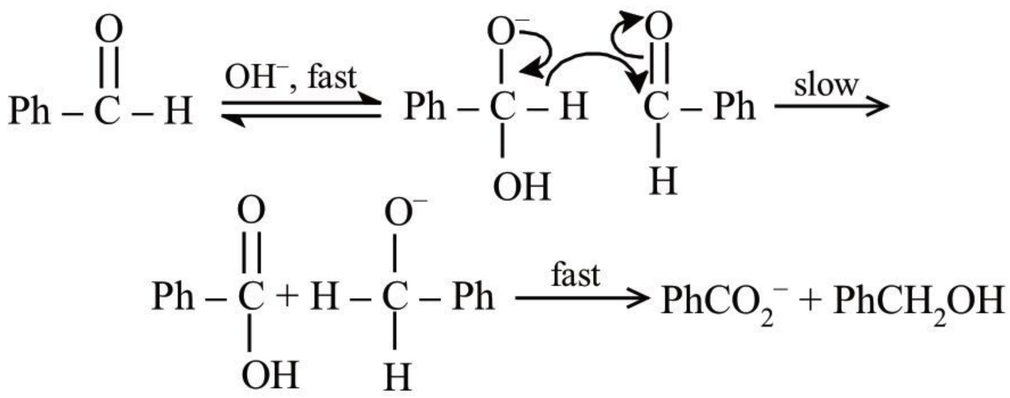
24. An aqueous solution of a salt (*A*) gives a white precipitate (*B*) with sodium chloride solution. The filtrate gives a black ppt. (*C*) when H_2S is passed into it. Compound (*B*) dissolves in hot water and the solution gives a yellow ppt.(*D*) on treatment with NaI. The compound (*A*) does not give any gas with dil. HCl but liberates reddish brown gas on heating. The change in the oxidation state of cation when it converts from (*A*) to (*B*) is _____.

25. A dilute aqueous solution of glucose shows a vapour pressure of 750 mm of Hg at 373 K. The molality of the solution is _____ m.

26. A weak field octahedral complex of Ni^{2+} has magnetic moment value of 2.82 B.M. The number of electrons in the t_{2g} level of Ni^{2+} will be _____.

Comprehension Type

Aldehydes which do not have any α-hydrogen atom when treated with a concentrated solution of NaOH or KOH, undergoes a simultaneous oxidation and reduction forming a salt of carboxylic acid and alcohol. This reaction is known as Cannizzaro reaction.



27. Which of the following aldehydes will show Cannizzaro reaction?

(a) HCHO (b) C_6H_5CHO

(c) $(CH_3)_3CCHO$ (d) All of these.

28. A mixture of benzaldehyde and formaldehyde on heating with concentrated NaOH solution gives

(a) benzyl alcohol and sodium formate

(b) sodium benzoate and methyl alcohol

(c) sodium benzoate and sodium formate

(d) benzyl alcohol and methyl alcohol.

Matrix Match Type

29. Match the compound in column I with property in column II and select the correct option.

	Column I		**Column II**
A.	Pyrophosphoric acid	p.	Dibasic
B.	Thiosulphuric acid	q.	has oxidation of +3 of central atom
C.	Orthophosphoric acid	r.	has +5 oxidation state of central atom
D.	Orthophosphorous acid	s.	tribasic

(a) A – p ; B – q, r; C – q, r; D – r, s

(b) A – p; B – q ; C – p, r; D – r

(c) A – r; B – p ; C – r, s; D – p, q

(d) A – r; B – q; C – p, q; D – r, s

30. Match the column I with column II.

	Column I		**Column II**
A.	Kertain	p.	Protein
B.	Haemoglobin	q.	β-Pleated sheet structure
C.	Riboflavin	r.	α-Amino acid
D.	Glycine	s.	Water soluble vitamin

(a) A – p, q ; B – q ; C – s ; D – p

(b) A – p, q ; B – p ; C – s ; D – r

(c) A – p, r ; B – r ; C – r ; D – r

(d) A – p, r ; B – s ; C – r ; D – p

Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....

No. of questions correct .....

Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

mtG

SUBSCRIBE NOW

SAVE ₹ 920/-*
with subscription plans

Get them uninterruptedly

SUBSCRIPTION FORM

☐ Student ☐ Teacher

Name: _____

_____

Complete Postal Address: _____

_____

Pin Code: _____ **Mobile No.:** _____

Email: _____

Confirm your choice by placing ✓ tick-mark in relevant boxes.

SELECT PLAN:

9 Months ☐ 15 Months ☐ 27 Months ☐

Individual Magazines

- ☐ PHYSICS FOR YOU (P)
- ☐ CHEMISTRY TODAY (C)
- ☐ MATHEMATICS TODAY (M)
- ☐ BIOLOGY TODAY (B)

Get Best Result in Combinations

- ☐ PCB Combo
- ☐ PCM Combo
- ☐ PCMB Combo

Subscription Price:

Months	27 Months	15 Months	9 Months
Individual Magazines Physics | Chemistry | Mathematics | Biology	₹ 850/- (Save ₹ 230/-)	₹ 500/- (Save ₹ 100/-)	₹ 300/- (Save ₹ 60/-)
Combo of 3 Magazines PCM | PCB	₹ 2500/- (Save ₹ 740/-)	₹ 1400/- (Save ₹ 400/-)	₹ 900/- (Save ₹ 180/-)
Combo of 4 Magazines PCMB	₹ 3400/- (Save ₹ 920/-)	₹ 1900/- (Save ₹ 500/-)	₹ 1200/- (Save ₹ 240/-)
Courier Charges Add to your subscription amount for quicker & reliable delivery	₹ 600/-	₹ 450/-	₹ 240/-

Note: Magazines are dispatched by Book-Post on 4th of every month (each magazine separately)

Recommended by (optional)

Name of your teacher: _____

Teacher's Mobile No.: _____

*on cover price

Enclose Demand Draft favouring
MTG Learning Media (P) Ltd. payable at New Delhi.
Mail this Subscription Form to Subscription Department.

MTG Learning Media (P) Ltd., Plot 99, Sector 44, Gurugram-122 003 (HR)

Get Digital Editions of MTG Magazines on http://digital.mtg.in/

subscription@mtg.in | www.mtg.in To subscribe online | 0124-6601200

NEET 2017

More than **60%** same or similar MCQs

NEET 2018

More than **80%** same or similar MCQs

NEET 2019

More than **80%** same or similar MCQs

NEET 2020

More than **85%** same or similar MCQs

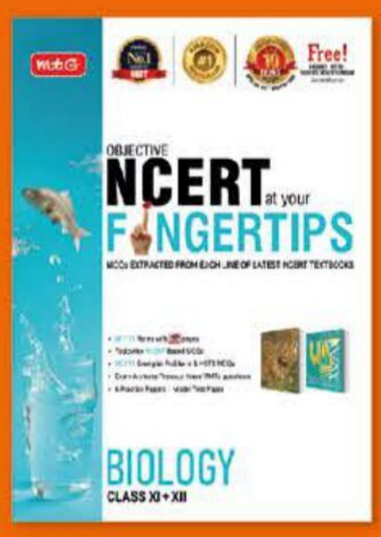
NEET 2021

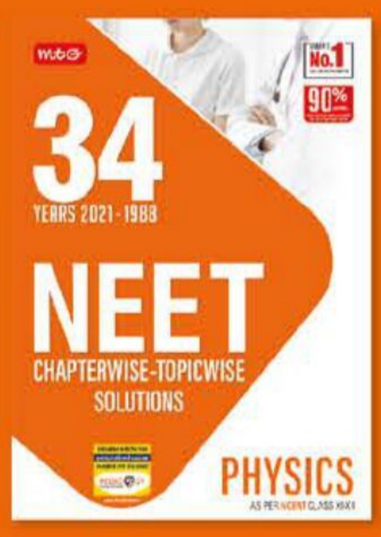
More than **90%** same or similar MCQs

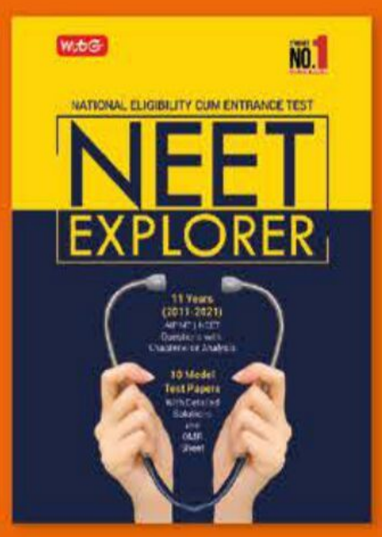
Trust MTG for getting it right, year after year

Over the last 5 years, MTG has averaged a hit rate of 79% when it comes to curating the right content for your NEET preparation. Which means approx. 3 out of 4 questions in NEET were either exactly the same as, or similar to, questions in MTG's NEET books. The credit for this mind-blowing feat goes to MTG's skilled and experienced editorial team which painstakingly goes through volumes of NCERT subject matter that forms the basis for NEET, to create superior and relevant study material that has a high chance of success for its users. Proof lies in the pudding, right!

#1 Bestseller on Amazon







Scan to buy on mtg.in

To find out which MTG NEET book is best-suited to your needs,
Call our NEET helpline **0124-6601200** today.
Or email **info@mtg.in** now. Visit bit.ly/mtg-neet to buy online.

mtG

Scan to buy on Amazon.in

Registered R.N.I. No. 53544/1991 *Published on 1st of every month* Postal Regd. No. DL-SW-01/4044/21-23
Lic. No. U(SW)-28/2021-23 to post without prepayment of postage LPC Delhi RMS, Delhi-06 on 2-3rd same month